IPmux-1, IPmux-1E

TDMoIP Gateways

Installation and Operation Manual

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Telecommunication Safety

The safety status of each of the ports on IPmux-1/1E is declared according to EN 41003 and is detailed in the table below:

Safety Status	**Ports**
SELV	LAN, Unbalanced E1, E&M, ISDN-S
TNV-1	Balanced E1, T1
TNV-2	FXS
TNV-3	FXO

SELV = Safety Extra-Low Voltage

TNV-1 = Telecommunications Network Voltage within the limits of SELV and subject to overvoltages

TNV-2 = Telecommunications Network Voltage not subject to overvoltages

TNV-3 = Telecommunications Network Voltage subject to overvoltages

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Manufacturer's Name: RAD Data Communications Ltd.

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declares that the product:

Product Name: IPmux-1

conforms to the following standard(s) or other normative document(s):

EMC: EN 55022 (1998) Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
EN 50024 (1998) Information technology equipment –Immunity characteristics – Limits and methods of measurement.

Safety: EN 60950/A4 (1996)Safety of information technology equipment, including electrical business equipment.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC. The product was tested in a typical configuration.

Tel Aviv, March 18th, 2001

Haim Karshen
VP Quality

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Chapter 1
Introduction

1.1 Overview

IPmux-1/1E offers a solution for extending traditional E1/T1, ISDN, or POTS TDM services transparently over the widely deployed IP networks. The device converts the data stream coming from its user ports into configurable sized IP packets that are extended over the Fast Ethernet port and vice versa. IPmux-1/1E offers end-to-end synchronization for voice applications. IPmux-1/1E also offers large buffers to compensate for the delay variation inserted by the network. The device can be used to extend E1/T1 or ISDN/POTS circuits over IP networks for Metropolitan Area Network applications. IPmux-1/1E also features a Fast Ethernet user port for data (Ethernet) connectivity to the IP/Ethernet network. Management is performed locally by a terminal, or remotely via Telnet or SNMP.

IPmux-1 has a single E1/T1 port.

IPmux-1E offers one of the following options:

- 4 BRI – a card with 4 ISDN standard S-interfaces
- 4 FXS – a card with 4 FXS ports
- Optional user Ethernet port.

The IPmux family implements TDMoIP technology to carry TDM transport over IP. IPmux-1E BRI channels are transported as TDM timeslots, while the Analog FXS channels are digitized and carried as fractional E1/T1 with CAS.

Versions

- **IPmux-1 with E1 interface**
  - Balanced line with an RJ-45 connector
  - Unbalanced line with a mini-coaxial connector (TBNC)
- **IPmux-1 with T1 interface –** Balanced with an RJ-45 connector
- **IPmux-1E with ISDN BRI interface –**4 ISDN 'S' RJ-45 connectors
- **IPmux-1E with FXS interface –** 4 Analog 'FXS' RJ-11 connectors

An external clock port is optional for IPmux-1.

A user Ethernet interface is optional for IPmux-1/1E (Ordering options).

Applications

Typical IPmux-1/1E applications are shown with E1/T1, ISDN, and FXS interfaces.

Figure 1-1 illustrates Multiplexing Voice and Data over an Ethernet Trunk.

Figure 1-2 shows an E1/T1 circuit extension over an IP based Network.

Figure 1-3 illustrates mixed BRI and POTS support application of V5.1 concentration of BRI remote terminals.

Figure 1-4

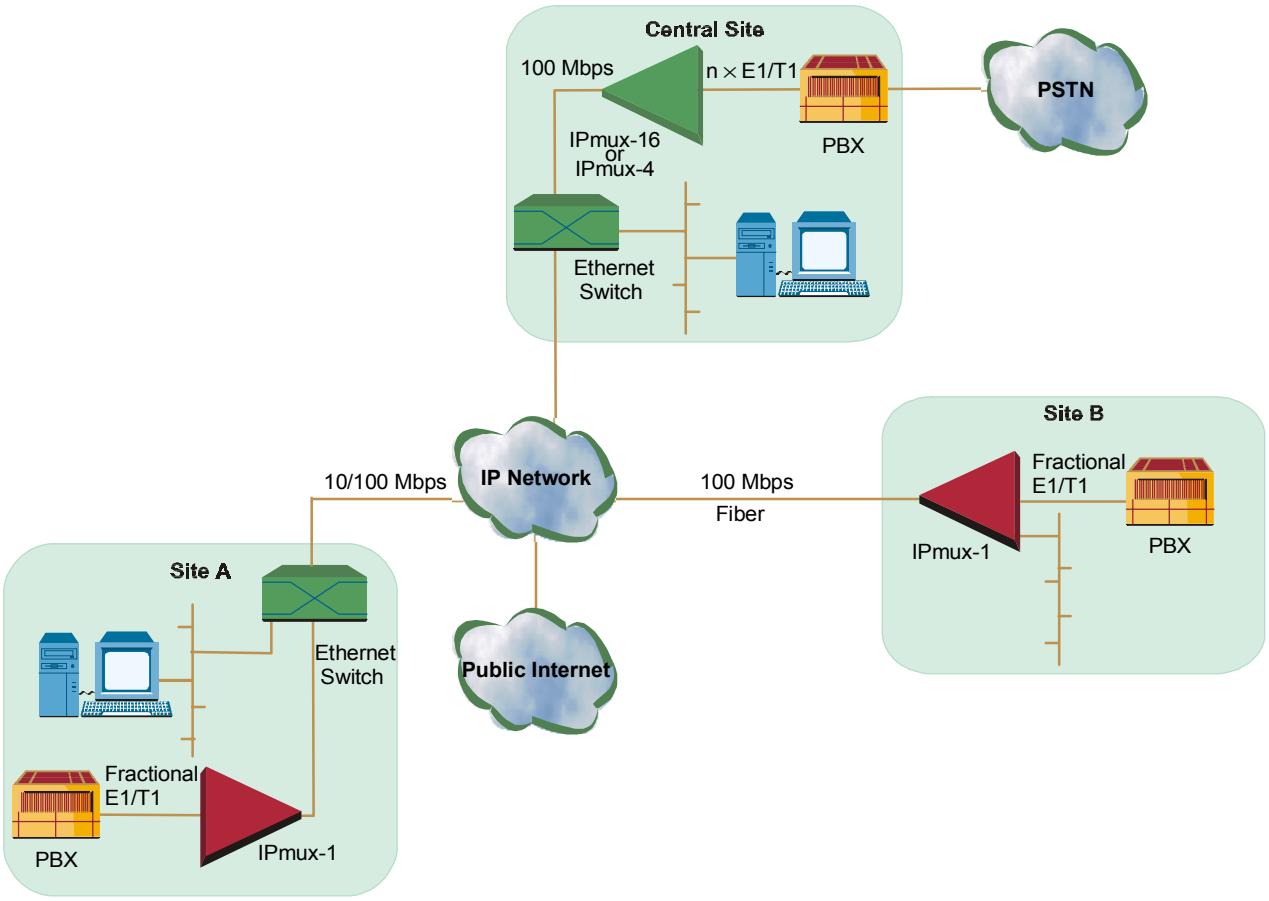


Figure 1-2. E1/T1 Circuit Extension over an IP Based Network

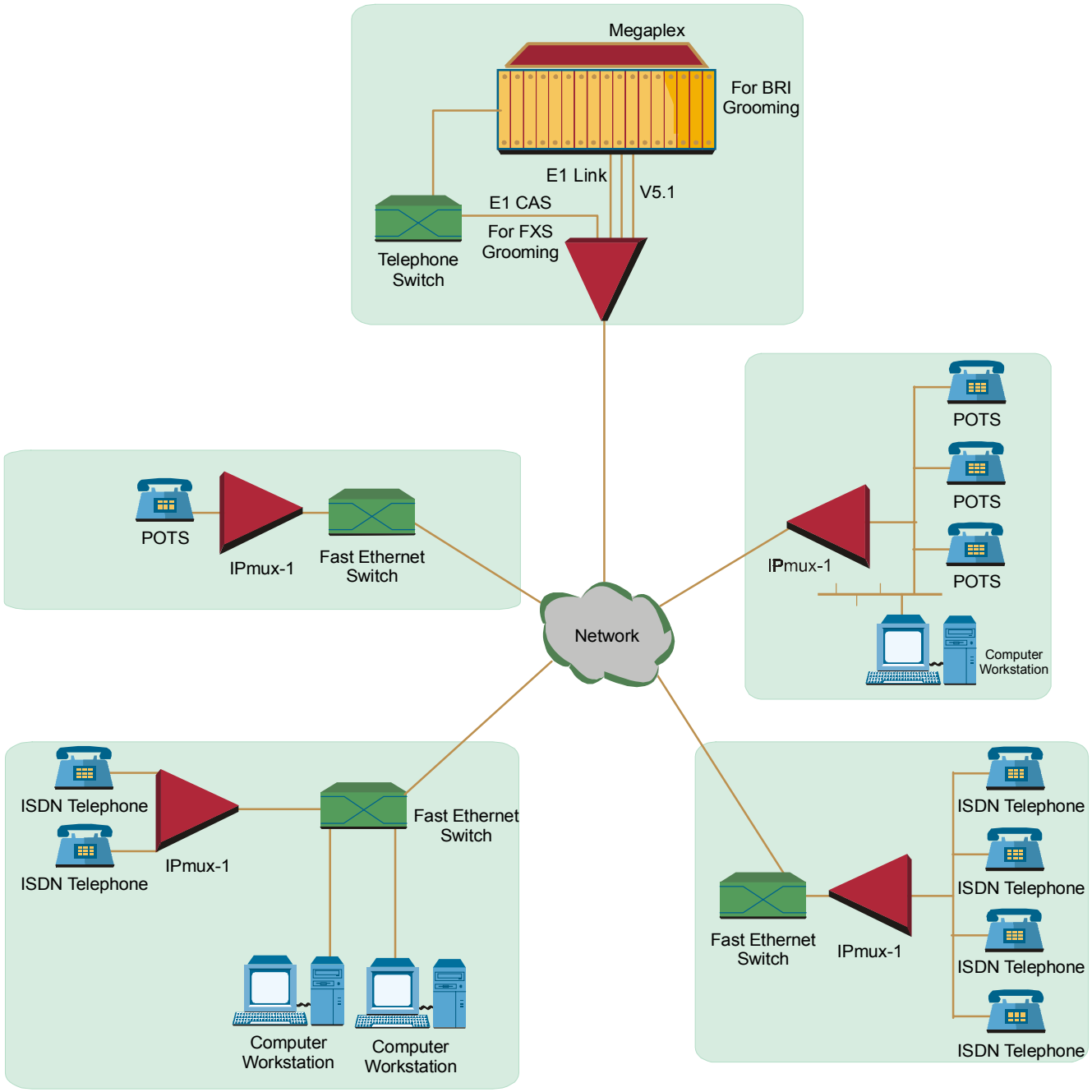
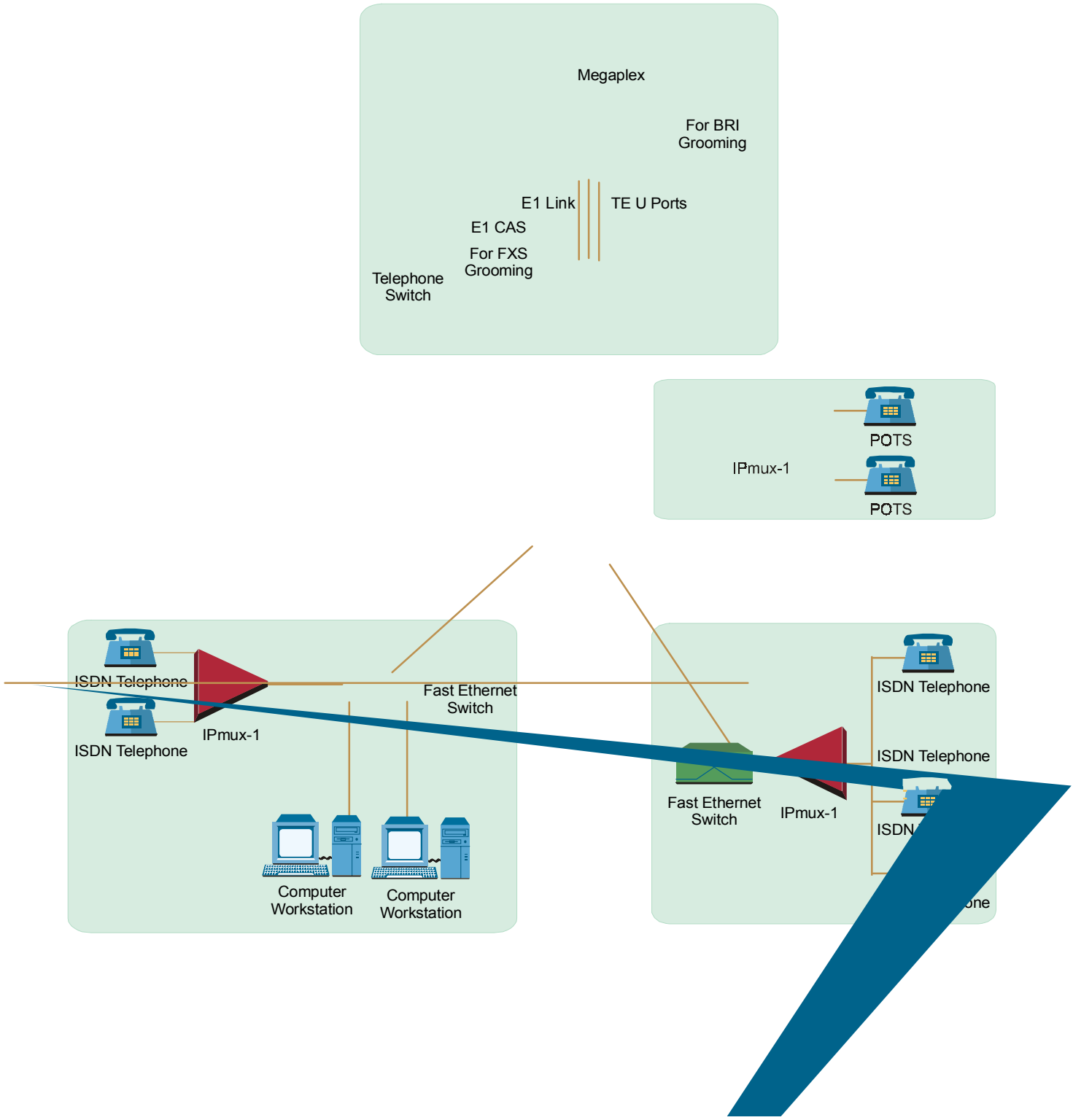


Figure 1-3. Mixed BRI and POTS Support Application (V5.1 Concentration of BRI Remote Terminals)


Megaplex
For BRI Grooming
E1 Link
TE U Ports
E1 CAS
For FXS Grooming
Telephone Switch
POTS
IPmux-1
POTS
ISDN Telephone
ISDN Telephone
IPmux-1
Fast Ethernet Switch
Computer Workstation
Computer Workstation
Fast Ethernet Switch
IPmux-1
ISDN Telephone
ISDN Telephone

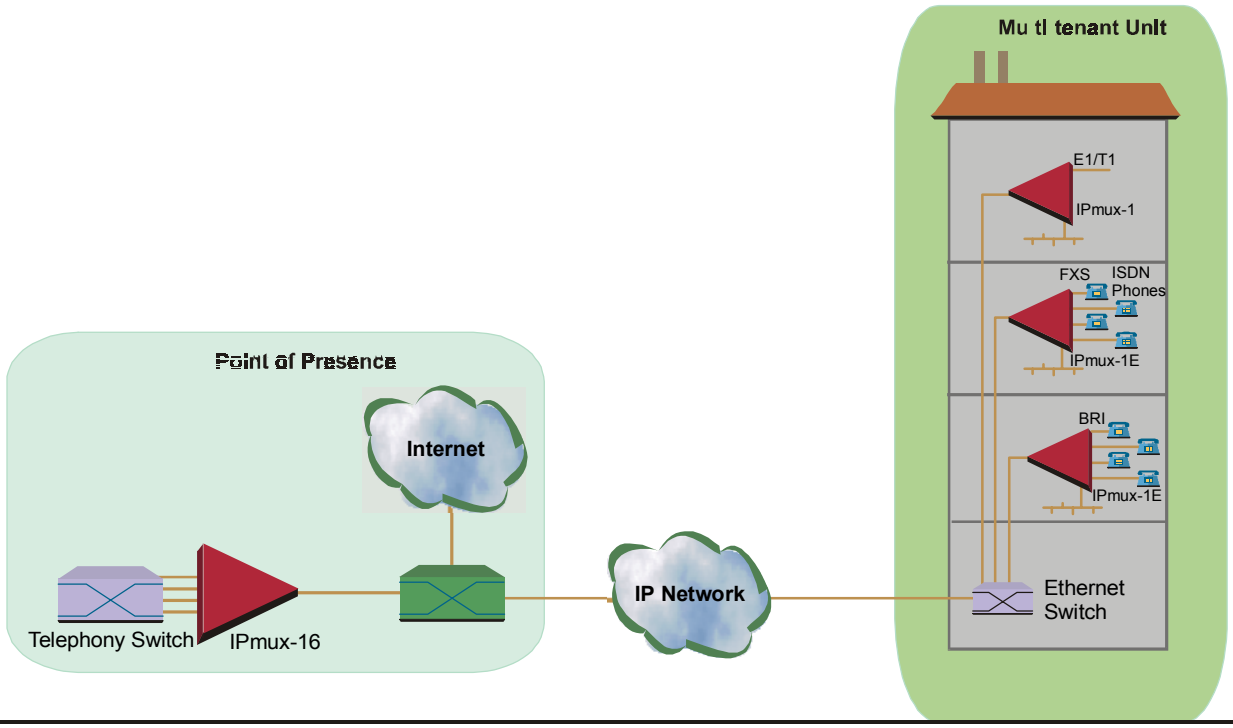


Figure 1-6. Ethernet-based Multi-tenant Application with Voice and Data Integrated Access

Features

IPmux-1/1E is a 1U high, easy-to-install standalone unit. A rack mount installation option is available.

IPmux-1 can be ordered with AC or DC power supply. IPmux-1E is only available with AC power supply.

Management

IPmux-1/1E can be managed locally by connecting an ASCII terminal to the RS-232 port on the front panel or remotely via Telnet or SNMP. The SNMP management capability enables fully graphical, user-friendly management using the RADview network management stations offered by RAD, as well as management by other SNMP-based management systems.

T1

The T1 port and framers comply with ANSI T1.403 standards. T1 jitter performance is according to G.704, G.824, TR-62411. The T1 framers support pass-through, SF, ESF and CAS framing. The T1 port supports long haul and short haul input signals and can be monitored for alarms and error statistics. FDL and transmit PRM for T1/ESF are also supported.

E1

The E1 port complies with G.703, G.704, and G.823 standards. E1 framers comply with G.704. The E1 framers support pass-through, framed, CRC4 MF and CAS MF framing. The E1 port supports long haul and short haul input signals and can be monitored for alarms and error statistics.

ISDN BRI

IPmux-1E has 4-ports, S-interface only. Each port can be configured as either NT or TE (Network/User) by jumper and software; NT or TE is configured per device.

IPmux-1E can be configured to 1, 2, 3 or 4 active ports.

IPmux-1E works in transparent mode (no termination/compression of D channels). It operates opposite IPmux with E1/T1 and a Megaplex unit as a concentrator in transparent mode or opposite another IPmux-1E with ISDN BRI ports.

FXS

IPmux-1E has 4 FXS interface ports for POTS connection. A central IPmux unit with an E1/T1 CAS interface can groom FXS channels from the remote site.

IP

The data stream coming from the E1 or T1 port is converted into IP packets that are transported over the Fast Ethernet port, and vice versa.

TDM bytes are encapsulated in a UDP frame that runs over IP and over Ethernet.

The number of TDM bytes in an IP frame is configurable for throughput/delay tradeoff.

Each device has a single IP address (Host IP). A configurable destination IP address is assigned to the IP packets. IP ToS field support can be configured for IP Level Priority.

Ethernet User Port

IPmux-1E has an optional user port for user LAN connectivity/access as well as TDM services connectivity. A transparent bridging mode is supported (user/network Ethernet port) and a second mode which enables user port rate limiting.

Ethernet Physical Port

IPmux-1/1E is available with Ethernet ports (user or network port). The Ethernet network port can be either UTP or fiber. The Ethernet user port is UTP only.

- **UTP option** – A standard 10/100BaseT half/full duplex port with auto-negotiation support. If auto-negotiation is disabled, IPmux-1 capabilities can be configured to 100BaseT – full duplex, 100BaseT – half duplex, 10BaseT – full duplex, or 10BaseT – half-duplex. Half-duplex operation in IPmux-1 network port is not recommended, because collisions and backoffs cause large delay variation and may exceed the delay variation buffer tolerance at the receiving end, causing buffer underflows and errors to occur.
- **Fiber option** – standard 100BaseF full duplex port (see *Table 1-1*).

Table 1-1. Fiber Options

Interface Type	Wavelength (nm)	Optical Power (dBm)

Note *IPmux E1/T1 working opposite IPmux-1E with BRI ports should work in Fractional E1/T1 mode (no CAS). When working opposite IPmux-1E with FXS, use E1/T1 CAS mode.*

QoS

QoS support:

- Labeling IP level priority (ToS) for TDMoIP packets
- VLAN tagging and priority labeling according to IEEE 802.1p&q for TDMoIP packets.

The user can configure the ToS (Type of Service) of the outgoing TDMoIP packets. This allows an en-route Layer 3 router or switch, which supports ToS, to give higher priority to IPmux-1/1E TDMoIP traffic for delay-sensitive and secure applications. IPmux-1 allows you to configure the **WHOLE** ToS byte field, since different vendors may use different bits to tag packets for traffic prioritization. This also enables you to work according to various RFC definitions (for example RFC 2474, RFC 791). The user can also configure VLAN priority bits for Level 2 Priority.

Timing

IPmux-1 maintains synchronization between TDM devices by deploying advanced clock distribution mechanisms.

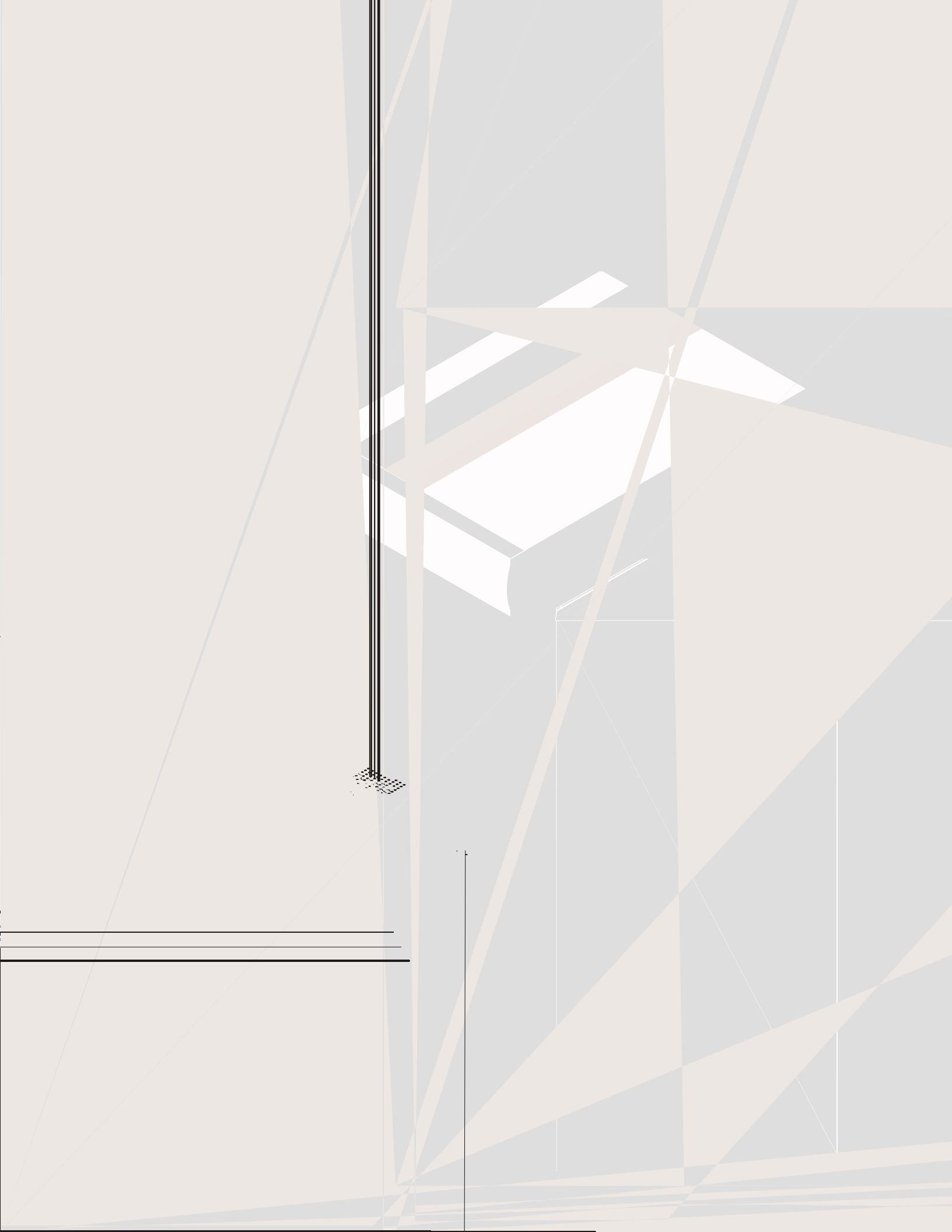
Available timing modes are:

- Loopback
- Adaptive
- Internal Clock
- External Clock.

Note *For more details see* Timing Modes in Section 1.3.

Standards

G.703, G.704, G.706, G.823, ANSI T1.403, AT&T TR-62411, G.824, IEEE 802.3, I.430, IEEE 802.3D, IEEE 802.1p&q, EMC Class B compliance – EN55022 Class B



Front Panel

The control interface and indicator LEDs are located on the front panel of IPmux-1/1E. For further details see *Chapter 2*.

Rear Panel

User and network ports and power supply are located on the rear panel of IPmux-1/1E. For further details see *Chapter 2*.

1.3 Functional Description

IPmux-1 supports a single E1 or T1 TDM interface; it provides TDM connectivity across the IP network. A single bundle (group of timeslots) can be transmitted to a predefined far-end bundle. IPmux-1 supports ICMP (ping), and generates ARP in case of unknown next hop MAC addresses, answers ARP requests, and supports 802.3 Ethernet format.

IPmux-1E supports 4 BRI or 4 FXS ports for transparent connectivity over the IP network.

Both IPmux-1 and IPmux-1E support Ethernet user port for user LAN connectivity.

Configuration and management are provided via the IPmux-1/1E local terminal, Telnet or RADview management tool (SNMP).

Figure 1-9 shows a typical application for IPmux-1.

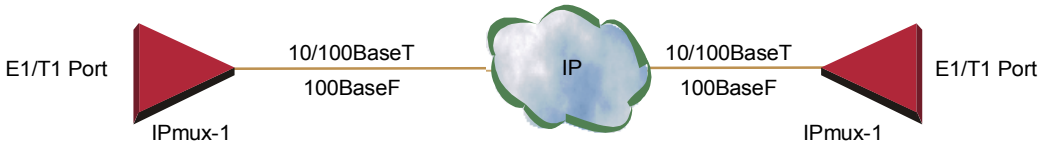


Figure 1-9. IPmux-1 Functional Diagram

IPmux-1/1E works in conjunction with the rest of the IPmux product line (see *Figure 1-10*). The combination of IPmux products provides up to 31 per E1 or 24 per T1 remote bundles, attached to one central IPmux-4/16 (see *Figure 1-10).*

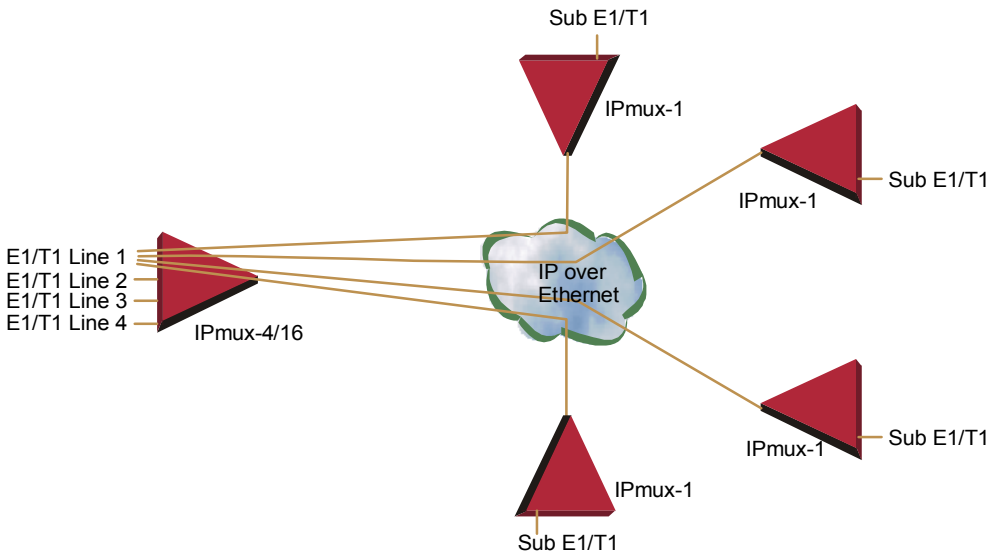


Figure 1-10. Grooming of Timeslots from Remote Sites into a Single E1/T1 Port at Central Site

Other BRI/FXS applications are shown in *Figure 1-3*, *Figure 1-4*, and *Figure 1-5*.

Operation Modes

IPmux-1 E1/T1

IPmux-1 E1/T1 operation modes are:

- Unframed
- Fractional
- Fractional with CAS.

Unframed

In the transparent mode, the incoming bit stream from each channel (regardless of framing) is converted into IP over Ethernet frames. This option provides clear channel end-to-end service (unframed).

Fractional

In the fractional mode, the incoming bit stream is regarded as a sequence of n x 64 kbps channel groups (according to framing). Each predefined group of channels is converted into a structure block. The structure block is packetized into IP frames and transmitted.

This mode allows transmission of several selected timeslots without the whole E1 or T1 frame, as in transparent mode.

Note *Use Fractional mode when grooming ISDN BRI channels from a remote IPmux-1E unit.*

Fractional with CAS

In the fractional-with-CAS mode, the structure block (as described under Fractional Operation Modes, above) also includes Channel Associated Signaling (CAS). The relevant portion of the signaling channel is packetized and sent to the destination.

Note *Use Fractional with CAS mode when grooming FXS channels from a remote IPmux-1E unit.*

IPmux-1E ISDN BRI

The IPmux-1E ISDN BRI S interface operation modes are:

- TE mode
- NT mode.

The selected mode applies to all 4 channels. The NT or TE mode is determined by phantom feeding and software setting, which is enabled/disabled by jumpers located on the BRI card (see *Chapter 2*).

TE Mode

All four channels are configured in TE (Terminal Equipment) as defined in I.430.

NT Mode

All four channels are configured in NT (Network Termination) as defined in I.430. TE Deactivation is not used in NT mode, and Layer 1 is in active mode all the time.

Note *If phantom feeding is enabled by the jumpers, the TE mode cannot be selected as the IPmux-1E operation mode. If phantom feeding is disabled, both NT and TE are valid options.*

IPmux-1E FXS

IPmux-1E FXS operates in:

- E1 mode
- T1-D4 mode
- T1 ESF mode.

The IPmux-1E FXS operation modes allow IPmux to work opposite E1, T1-D4, or T1-ESF. Two parameters are set internally when choosing one of the options:

- A-Law/μ-Law
  - A-Law when E1 mode is selected
  - μ-Law is used in PCM CODEC when T1 (D4 or ESF) is selected.
- E1, T1-D4, and T1-ESF with CAS are structured differently in the TDM ↔IP interworking function. A different structure must be used when working opposite each one.

BRI/FXS TS Assignment in a Bundle

BRI

The TS assignment in a Bundle for IPmux-1E with BRI (when working opposite IPmux with E1/T1 or Megaplex) is assigned as follows:

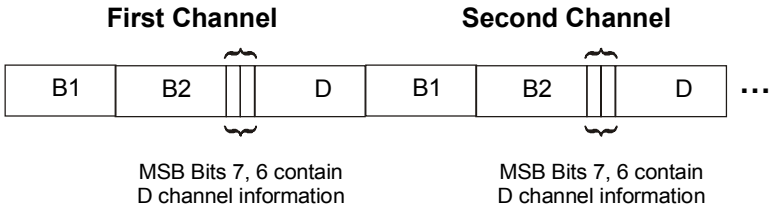


Figure 1-11. TS Assignment in a Bundle for IPmux-1E/BRI

As shown in *Figure 1-11,* the 4 BRI channels consume 12 timeslots in the Bundle. The E1/T1 IPmux should work in framed mode (no CAS).

The three TS groups in the bundle are assigned according to BRI channel numbers; the first group is assigned to the lowest BRI channel that is enabled, etc.

FXS

The TS assignment in a Bundle for IPmux-1E with FXS is straightforward. Each timeslot in a Bundle is assigned to a specific FXS channel. Time slots in the bundle are assigned according to FXS channel numbers; the first timeslot is assigned to the lowest FXS channel that is configured, etc. As shown in *Figure 1-11,* the 4 FXS channels consume 4 timeslots in the Bundle.

The E1/T1 IPmux that works opposite the FXS channels should work in Framed with CAS mode.

Testing

Diagnostic capabilities include E1/T1 or BRI S local and remote loopback tests for rapid localization of faults. The E1/T1 or BRI S channel can be looped locally, toward the line, or toward the remote end (see *Chapter 4* for more information).

Remote Loopback and Tone Injection are available for the FXS port.

Timing Modes

The E1/T1 Tx clock, or ISDN/FXS PCM clock, can operate in several timing modes to provide maximum flexibility for connecting the IPmux-1 E1, T1, ISDN or FXS channels.

Each of the clocks must be configured correctly on both the Receive and Transmit ends to ensure proper operation and prevent pattern slips (see *Figure 1-12*, *Figure 1-14*, and *Figure 1-15*).

E1/T1

The E1/T1 available Tx modes are:

- Loopback Timing – the E1/T1 Tx clock is derived from the E1/T1 receive (Rx) clock.
- Adaptive Timing – in this mode, the E1 or T1 Tx clock is regenerated using the Adaptive method. In this method, the fill level of the buffer receiving packets is monitored. If the buffer begins to overfill, the regenerated Tx clock frequency increases to avoid overflow. If the buffer begins to empty, the Tx clock (toward the TDM device) decreases to avoid underflow.
- Internal Clock Timing – in this mode, the Tx clock is received from an internal oscillator.
- External Clock Timing – in this mode the Tx clock is taken from the external clock input (Ordering option). The External Clock port also outputs the input clock signal to allow connection to other units, if needed.

Note *In Adaptive Timing mode the regenerated clock is subject to network Packet Delay Variation and may not comply with jitter and wander specifications.*

FXS/BRI

The available timing modes for the PCM clock are:

- Loopback Timing – available only when IPmux-1E BRI is configured as TE (not available in BRI NT mode or for FXS interface). In this mode the PCM clock is derived from Channel 1.

Warning **It is recommended not to deactivate Channel 1 while it is in loopback clock so that data will not be damaged. If Channel 1 is disconnected or deactivated (by the NT side), the PCM clock will change to Internal clock and a momentary disruption will occur to the other channels (2,3,4), if they are active.**

- Adaptive Mode – the clock is regenerated using the Adaptive method, where the rate of arriving packets is used to regenerate the clock (see E1/T1).
- Internal Mode – the clock is received from an internal oscillator.

Network Timing Schemes

The following paragraphs describe typical timing schemes and the correct timing mode settings for achieving end-to-end synchronization.

External Network Timing

When the edges of the network are synchronized according to an external network clock source, all the IPmux-1 units should be configured to work in loopback timing mode (see *Figure 1-12*). This topology enables any-to-any connectivity.

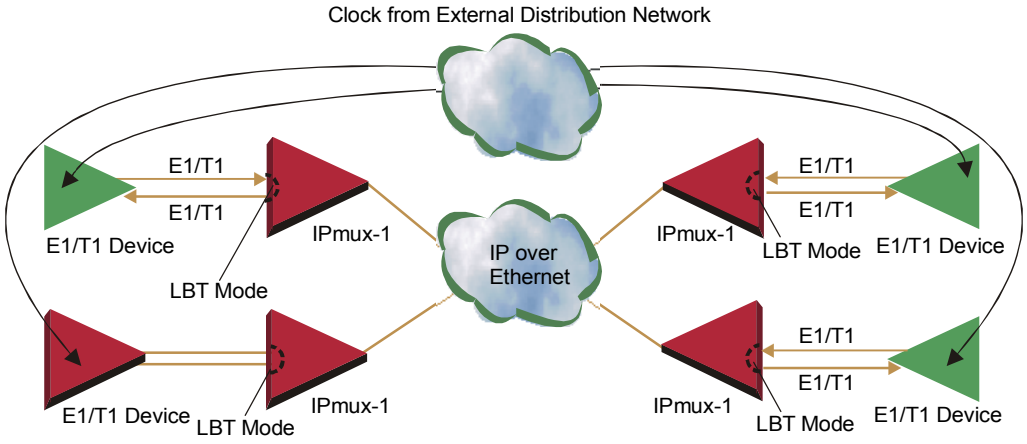


Figure 1-12. IPmux-1 in Loopback Timing Mode

External timing from the network can also be issued to IPmux-1 by External Clock input; in this case, the E1/T1 device will use the LBT mode.

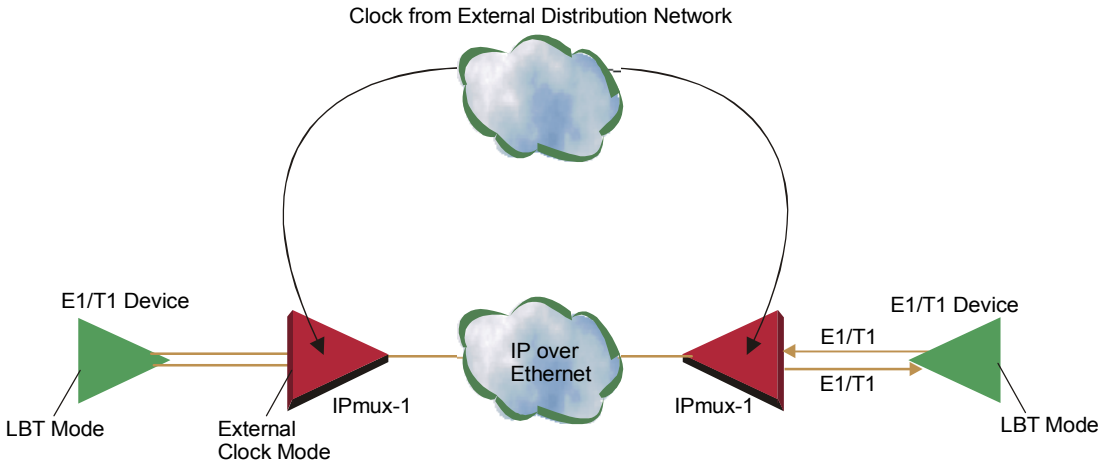


Figure 1-13. IPmux-1 in External Clock Mode

Single Source Clock Network

When a common clock is not available on all the ends of the network one of the IPmux-1 devices is configured to work in Loopback timing mode, while the other IPmux-1 device is configured to work in Adaptive timing mode (see *Figure 1-14*).

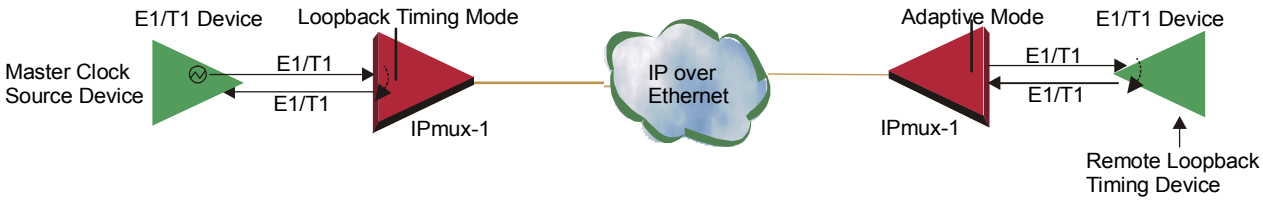


Figure 1-14. IPmux-1 in Adaptive Timing Mode

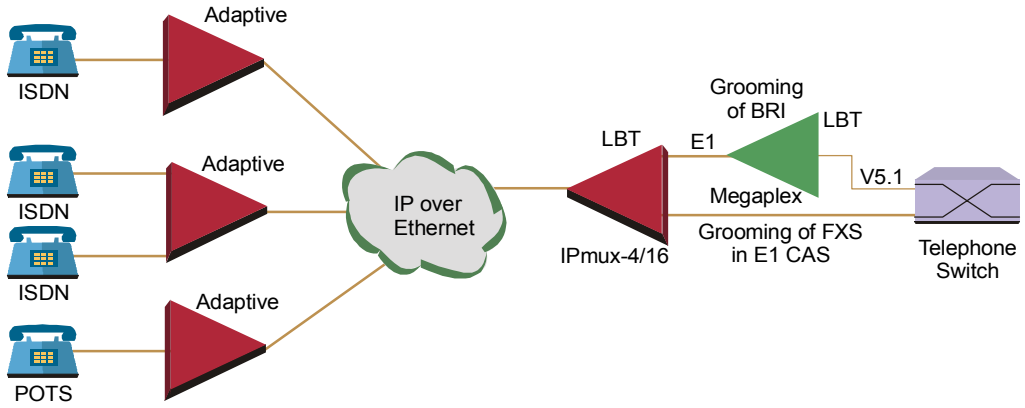


Figure 1-15. IPmux-1E in Adaptive Timing Mode

Frame Format

The Ethernet frame sent by the IPmux-1 is a UDP datagram that transfers E1/T1 payload bytes over IP over Ethernet (UDP payload + UDP header + IP header + Ethernet header).

The UDP payload size is equal to TDM bytes per frame (TDM bytes/frame configuration).

Table 1-2 specifies the structure of the different headers, special fields, and the payload in the Ethernet packet.

Figure 1-16. TDMoIP Frame Structure

Table 1-2. Ethernet Frame Structure

	Field length (bytes)	Field	
MAC Layer	7	Preamble	
	1	SFD	
	6	Destination MAC Address	
	6	Source MAC Address	
LLC Layer	2	Type	***Note:*** *IEEE 802.1p&q VLAN Tagging (additional 4 bytes if enabled)*
IP Layer	1	Vers/HLEN	
	1	Service Type	
	2	Total Length	
	2	Identification	
	1	Flags/Fragment Offset (most)	
	1	Fragment Offset (least)	
	1	Time to Live	
	1	Protocol	
	2	Header Checksum	
	4	Source IP Address	
	4	Destination IP Address	
UDP Layer	2	UDP Source Port	***Note****: The UDP source port field is used to transfer the destination bundle number.*
	2	UDP Destination Port	
	2	UDP Message Length	
	2	UDP Checksum	
Data Layer	...	Payload	
MAC Layer	4	CRC	

VLAN Support

VLAN, according to IEEE 802.1p&q, adds four bytes to the MAC layer of the Ethernet frame. The contents of these bytes, MAC layer priority and VLAN ID, can be set by the user. In this mode, only VLAN format frames are sent and received by IPmux-1. *Figure 1-17* describes the VLAN tag format.

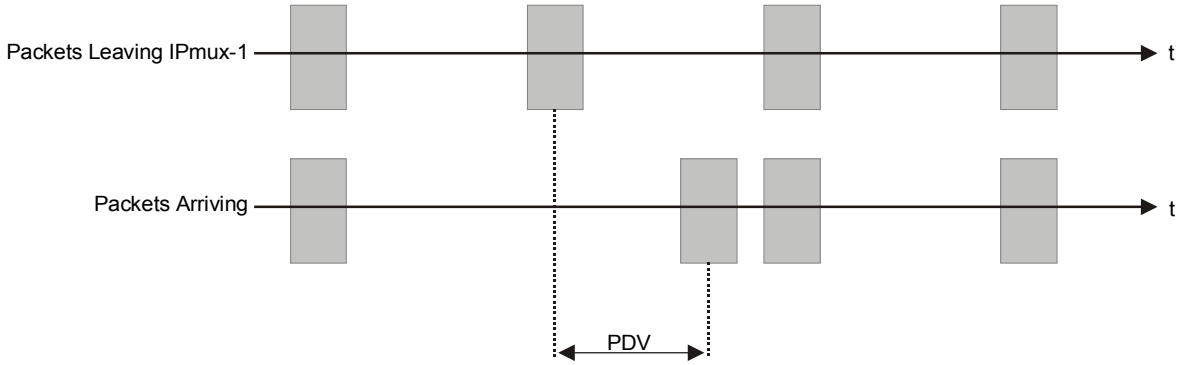


Figure 1-18. Packet Delay Variation

PDVT (Jitter) Buffer

IPmux-1 is equipped with a Packet DVT (Delay Variation Tolerance) buffer. The PDVT buffer or jitter buffer is filled by the incoming IP packets and emptied out to fill the E1/T1 stream. The buffer begins to empty out only after it is half full in order to compensate for packet starvation from the Ethernet side. The time it takes for half of the buffer to empty out is the maximum DVT time. Delay Variation Tolerance is configurable. The PDVT (jitter) buffer is designed to compensate for packet delay variation caused by the network + intrinsic PDV.
It supports a delay variation of up to 300 ms for E1 or T1.

➤ **To configure jitter buffer depth:**

Estimated or Measured PDV introduced by the network + intrinsic PDV (if it exists) introduced by the module as a result of configuring the TDM bytes / frame > 48 (see explanation of calculating intrinsic PDV, below).

Intrinsic PDV

If TDM bytes/frame is greater than 48, there is an intrinsic delay variation (intrinsic PDV). The intrinsic PDV introduced by the module is a function of n>1 in TDM bytes/frame configuration as follows:

I.PDV (ms) = [(n-1) x 1000) / (frames per second × n]

$$\text{where } n = \frac{\text{Configured TDM bytes/frame}}{48} \quad (n = 1 \text{ to } 8).$$

Note *For a bundle that contains a few timeslots (i.e. 1–3) the minimal jitter buffer should be 6 ms.*

PDVT Buffer Effect on Delay

The PDVT buffer is on the TDM path; it adds to the total end-to-end delay (see delay calculation, below).

Ethernet Throughput

Configuring the TDM bytes per frame (TDM bytes/frame) parameter can reduce Ethernet throughput (bandwidth or traffic travelling through the Ethernet). This parameter controls the number of TDM bytes encapsulated in one frame. The TDM bytes/frame parameter can be configured to n x 48 bytes where n is an

integer between 1 and 8. Configuring TDM bytes/frame to a higher value reduces the IP/Ethernet overhead segment of the total packet and thus can significantly reduce the total Ethernet throughput.

On the other hand, packetization delay and intrinsic packet delay variation (PDVT) are increased; this contributes to a higher end-to-end delay. This effect can be small and negligible when a full E1 (or many timeslots) are transferred but can be very significant when few timeslots are transferred. In this case, the packetization delay and the intrinsic PDV when configuring a large value of TDM bytes/frame can be very large and may exceed the maximum PDVT (jitter) buffer on the receiving end. *Table 1-4* and *Table 1-5* show throughput as a function of the TDM bytes/frame configuration for full E1 and full T1.

Table 1-4. Ethernet Throughput – Unframed E1

TDM bytes/frame	**Frame Length** (bytes)	**Overhead** (bytes)	**Overhead** (%)	**Packets per Second**	**Throughput** (Mbps)
48	94	46	96	5447	4.1
96	142	46	48	2724	3.1
144	190	46	32	1816	2.76
192	238	46	24	1362	2.6
240	286	46	19	1089	2.5
288	334	46	16	908	2.43
336	382	46	14	778	2.38
384	430	46	12	681	2.34

Table 1-5. Ethernet Throughput – Unframed T1

TDM bytes/frame	**Frame length** (bytes)	**Over head** (bytes)	**Over head** (%)	**Packets per Second**	**Throughput** (Mbps)
48	94	46	96	4107	3.08
96	142	46	48	2054	2.32
144	190	46	32	1369	2.07
192	238	46	24	1027	1.95
240	286	46	19	821	1.87
288	334	46	16	685	1.82
336	382	46	14	587	1.78
384	430	46	12	513	1.76

➤ **To calculate Ethernet throughput and intrinsic PDV as a function of TDM bytes/frame:**

Ethernet load (bps) =
[(frame overhead (bytes) + TDM bytes/frame) x 8] x frames/second

Frame overhead = Ethernet overhead + IP overhead = 46 bytes

Note *The frame overhead does not include:*
Preamble field: 7 bytes
SFD field: 1 byte
VLAN field (when used): 4 bytes.

Frame/second =

Unframed: 5447/n for a full E1
4107/n for a full T1

Framed: 8000 x k/(46.875 x n)
Where k = number of assigned timeslots
Where $n = \frac{\text{TDM bytes/frame}}{48}$

Round Trip Delay

The voice path round-trip delay, which is a function of all connections and network parameters, is calculated for E1/T1 as follows:

$$(\pm 2\ \mu s)\ RTDelay_{(\mu s)} = 2 \times \left(\frac{48 \times n}{NTS} \times 125\ (\mu s) + \text{PDVT buffer}\ (\mu s) + 1000\ \mu s\right) + \text{Network Round Trip Delay}$$

where $n = \frac{\text{TDM bytes/frame}}{48}$

where NTS = number of timeslots assigned
in unframed E1 interface = 32
T1 interface = 24

End-to-End Alarm Generation

An end-to-end alarm generation mechanism exists in IPmux-1 to facilitate the following alarms:

Unframed — AIS is transmitted toward the near-end PBX in event of:
- Far-end LOS, AIS
- PDVT underflow/overflow.

Framed — Timeslot/CAS configurable alarm pattern is transmitted toward the near-end PBX in event of:
- Far-end LOS, LOF, AIS
- PDVT underflow/overflow.

Ethernet User Port

The Ethernet user port allows a user to aggregate both TDMoIP traffic and his private network LAN traffic to a single Ethernet network connection without requiring an access switch. This is a cost effective solution for MTU or small office applications. A rate limiter to restrict user port traffic is supported.

IPmux-1/1E contains an internal switch where one of its ports is connected to a TDMoIP interworking function, another internal switch port is used as the user port, and the third is used as an Ethernet network port.

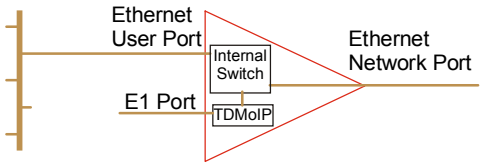


Figure 1-19. IPmux-1/1E with Ethernet User Port

Note *Priority is always given to TDMoIP packets inside the internal switch.*

Internal Switch Operation Modes

Bridge Mode (no user rate limiter)

In this mode the internal switch performs transparent bridging, ALL internal ports learn, update the internal tables, and make forwarding decisions according to the source MAC only (not MAC + VLAN ID).

VLAN tagged frames are supported, however forwarding decisions are based on MAC only.

Rate Limiter Mode

In this mode a rate limiter is available to limit user port traffic. This feature is valuable when a limited bandwidth DSL modem, for example, is used to extend the Ethernet link (generally when the Ethernet link rate is limited/shaped to a lower rate after IPmux). In this case TDMoIP packets will be dropped in the modem even if it was prioritized at the IPmux internal switch. This is prevented by limiting the user port to actual link rate minus TDMoIP bandwidth. The rate limiter can limit user traffic at 50 kbps steps up to 5M and in 1 Mbps steps from 5M to 100M.

The internal switch (in the rate limiter mode) operates in the following way:

- The network port is in lock mode (no learning takes place). If this port must be connected to a switch (not a hub), this is not a limitation, since all applications involve connection to a backbone on an access switch.
- VLAN tagged frames are not supported (will be dropped)
- Access to the IPmux host for management is possible only from the network port.

Note *All of the above exist only in rate limiting mode, and do not exist in bridge mode.*

The bridge/rate limiter modes are selected by the rate limiter parameter. When set to 0 the bridge mode is selected, otherwise the rate limiter is selected by the specified rate.

1.4 Technical Specifications

E1 Port	*Compliance*	ITU-T Rec. G.703, G.706, G.732, G.823
	Connector	Balanced: RJ-45 8-pin Unbalanced: TBNC 75Ω (an external adapter cable from TBNC to BNC is required)
	Data Rate	2.048 Mbps
	Line Code	HDB3
	Line Impedance	Balanced: 120Ω; Unbalanced: 75Ω
	Signal Levels	Receive: 0 to –32 dB with LTU 0 to –10 dB without LTU Transmit Balanced: ±3V ±10% Transmit Unbalanced: ±2.37V ±10%
	Jitter Performance	ITU-T G.823 standard
	External Adapter Cable	TBNC to BNC required
E1 Framing	*Compliance*	G.704, G.706
	Framing	Pass Through, CRC4 MF, CAS MF
	Signaling	CAS, CCS (transparent)
T1 Port	*Compliance*	ANSI T1.403, ITU-T Rec. G.703, G.704
	Connector	RJ-45, 8-pin
	Data Rate	1.544 Mbps
	Line Code	B8ZS, B7ZS, AMI
	Line Impedance	Balanced: 100Ω
	Signal Levels	Receive: 0 to –30 dB Transmit: 0 dB, –7.5 dB, –15 dB, –22.5 dB, with CSU ±2.7V ± 10%, adjustable, measured in range 0 to 655 feet, without CSU
	Jitter Performance	AT&T TR-62411, G.824 standards

T1 Framing	*Compliance*	ANSI T1.403
	Framing	Pass through, SF, ESF
	Signaling	CAS (bit robbing), CCS (transparent)
Local Terminal and Control Interface		DB-9, female
	Mode	RS-232/V.24 (DCE)
	Baud Rate	9.6, 19.2, 38.4, 57.6, 115.2 kbps
	Connector	DB-9
Ethernet	*Compliance*	IEEE 802.3, 802.3u, Ethernet, 802.1p&q
	Connector	UTP: RJ-45, 8-pin Fiber: SC (without user port), LC (with user port)
	Ports	1 or 2 (if user port is used)
	Data Rate	UTP: 10 Mbps or 100 Mbps, full or half duplex Fiber: 100 Mbps full duplex
	Range	Up to 100m on UTP Category 5 cables For optical interfaces: see optical budget calculation (*Features*)
Analog Voice	*Number of voice channels*	4
	Modulation method	PCM (per ITU-T G.711 and AT&T PUB-43801) µ-Law or A-Law
	Interfaces	FXS: Loop start for direct connection to a 2-wire telephone Nominal level: 0 dBm Nominal impedance: 600Ω Return loss (ERL): Better than 20 dB Frequency response: (Ref: 1020 Hz) • ±0.5 dB, 300 TO 3000 Hz • ±1.1 dB, 250 to 3400 Hz Signal to total distortion, G.712, G.713 method 2: • 0 to –30 dBm0, better than 33 dB • +3 to –45 dBm0, better than 22 dB Idle channel noise: Better than –70 dBm0 (+20 dBrnc)

		Transformer isolation: 1500 VRMS
		Ringing – 22 Hz, sine wave
	Diagnostics	Remote analog loopback towards the remote side, activated from local side
		1kHz tone injection towards analog side Activity indicators
ISDN S0 Interface	*Number of ports*	4
	Compliance	ETS 300012, I.430, NTT, 5ESS, DMS-100, NI1
	Bit Rate	192 kbps
	Line Coding	Pseudo-ternary
	Line Termination	100 ± 5%
	Connector	RJ-45
External Clock		
E1	*Compliance*	ITU-T Rec. G.703, G.706, G.732, G.823
	Connector	Balanced: RJ-45 8-pin Unbalanced: TBNC 75Ω (an external adapter cable from TBNC to BNC is required)
	Data Rate	2.048 Mbps
	Line Code	HDB3
	Line Impedance	Balanced: 120Ω; Unbalanced: 75Ω
	Signal Levels	Receive: 0 to –10 dB Transmit Balanced: ±3V ±10% Transmit Unbalanced: ±2.37V ±10%
	Jitter Performance	ITU-T G.823 standard
	External Adapter Cable	TBNC to BNC required
T1	*Compliance*	ANSI T1.403, ITU-T Rec. G.703, G.704
	Connector	RJ-45, 8-pin
	Data Rate	1.544 Mbps
	Line Code	B8ZS, B7ZS, AMI
	Line Impedance	Balanced: 100Ω

Signal Levels

Receive: 0 to –10 dB
Transmit: ±2.7V ± 10%, adjustable, measured in range 0 to 133 feet, without CSU

Jitter Performance

AT&T TR-62411, G.824 standards

Indicators

General:

PWR	ON when power supply is OK OFF when a malfunction is detected
RDY	ON when self-test is successfully completed OFF during self-test BLINKS when self-test fails

Ethernet Port:

LINK	OFF when line is not active ON when line is OK
ACT	OFF when no activity ON when a frame is being transmitted or received on the line
100M	OFF when 10 MHz ON when 100 MHz
FDX	OFF when half duplex ON when full duplex

E1/T1 Port:

SYNC	ON when the port is synchronized (no alarm) OFF when signal loss, LOF or AIS is detected (local alarm) BLINKS when RDI is detected (remote alarm)

ISDN Port:

SYNC	ON when the ISDN BRI frame is synchronized (no alarm) OFF when signal loss, LOF is detected

FXS Port:

SYNC	ON when off-hook OFF when on-hook BLINKS when ringing

Note: *All LEDs are green and ON after power-up.*

Power

1 power supply
100 to 240 VAC, 50 or 60 Hz
–36 to –72 VDC (–48 VDC nominal)

Note: *IPmux-1E only has AC power supply option.*

Power consumption	IPmux-1: 4W IPmux-1 (with LAN): 10W IPmux-1E: 25W IPmux-1E (with LAN switch): 32W
Physical	
IPmux-1	Height 4.4 cm/1.7 in (1U) Width 21.4 cm/8.4 in Depth 24.6 cm/9.7 in Weight 1.2 kg/2.7 lb
IPmux-1E	Height 4.4 cm/1.7 in (1U) Width 43.2 cm/17.0 in Depth 24.6 cm/9.7 in Weight 2.3 kg/5.1 lb
Environment	Temperature: 0 to 50°C/32 to 122°F
Humidity	Up to 90%, non-condensing

Chapter 2
Installation

This chapter includes:

- Site requirements and prerequisites
- Package contents
- Equipment needed
- Installation and setup

2.1 Introduction

IPmux-1/1E is delivered completely assembled for bench-top installation. The only mechanical installation procedures that may be necessary are optional installation in a 19-in rack. For rack installation instructions refer to the *Rack Mounting Kit for 19-inch Racks* guide that comes with the RM kit.

After installing the unit, configure IPmux-1/1E using an ASCII terminal connected to the IPmux-1/E Control port, or Telnet or RADview TDMoIP management application. The IPmux-1/1E configuration procedures are described in *Chapter 3* and *Appendix E* of this manual. Configuration parameters are explained in *Appendix E*.

If problems are encountered, refer to *Chapter 4* for test and diagnostics instructions.

Warning

No internal settings, adjustment, maintenance and repairs may be performed by either the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved.
Always observe standard safety precautions during installation, operation, and maintenance of this product.

2.2 Site Requirements and Prerequisites

Install AC-powered IPmux-1/1E units within 1.5m (5 feet) of an easily-accessible grounded AC outlet capable of furnishing the required supply voltage, in the range of 100 to 240 VAC.

DC-powered IPmux-1 units require a 48 VDC power source. The positive pole can be earthed.

Caution The DC power source must be isolated from the mains supply by double or reinforced insulation. A suitable fuse or a circuit breaker should be integrated in the negative power-supply line.

Allow at least 90 cm (36 inches) of frontal clearance for operator access. Allow at least 10 cm (4 inches) clearance at the rear of the unit for cable connections. Make sure that the ventilation holes are not blocked.

The ambient operating temperature of IPmux-1/1E is 0º to 50º C (32º F to 122º F), at a relative humidity of up to 90%, non-condensing.

2.3 Package Contents

The IPmux-1/1E package contains the following items:

- IPmux-1/1E unit
- Power cord
- Kit containing hardware for mounting the unit in a 19-in rack (optionally supplied)
  - RM-25 for IPmux-1
  - RM-27 for IPmux-1E.

Power Cable

IPmux-1/1E comes equipped with the power cord connected to the AC/DC interface on the rear panel.

2.4 Equipment Needed

IPmux-1/1E needs no special tools for installation. A screwdriver is necessary when mounting IPmux-1/1E in a 19-in rack.

2.5 Installation and Setup

Setting Jumpers

IPmux-1

In general, IPmux-1 internal jumpers and switches do not need to be configured by the user. Therefore, removing the product cover is not required.

IPmux-1E

The IPmux-1E FXS version needs NO user internal jumper configuration.

The IPmux-1E ISDN version contains jumpers for phantom feed (see *Figure 2-1*). Open the case and check the positions of internal jumpers before the IPmux-1E installation.

➤ **To open the IPmux-1E case:**

1. Disconnect all the cables connected to the IPmux-1E.
2. Release the cover screws at the rear panel (one is near the POWER connector).
3. Slide the IPmux-1E top cover by pulling it straight out.

➤ **To set the IPmux-1E ISDN-S module jumpers:**

If necessary, change the settings in accordance with the specific requirements of your application:

- ENA – enable phantom feed
- DIS – disable phantom feed

The phantom feed ENA/DIS setting influences the IPmux-1E BRI operation mode. When phantom feed is disabled, the S interface can be configured (through software) to the TE or NT mode. When phantom feed is enabled, only the NT mode is possible.

Warning

Only qualified and authorized service personnel should have access to the inside of the unit.

Disconnect the unit from the power line and from all the cables before removing the cover.

Line voltages are present inside IPmux-1E when it is connected to power. Moreover, under certain external fault conditions, dangerous voltages may appear on the lines connected to IPmux-1E.

Any adjustment, maintenance, and repair of the opened device under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled technician who is aware of the hazards involved. Capacitors inside the device may still be charged even after it has been disconnected from its source of power.

Caution The IPmux-1E contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components, and before moving jumpers, touch the IPmux-1E rear panel.

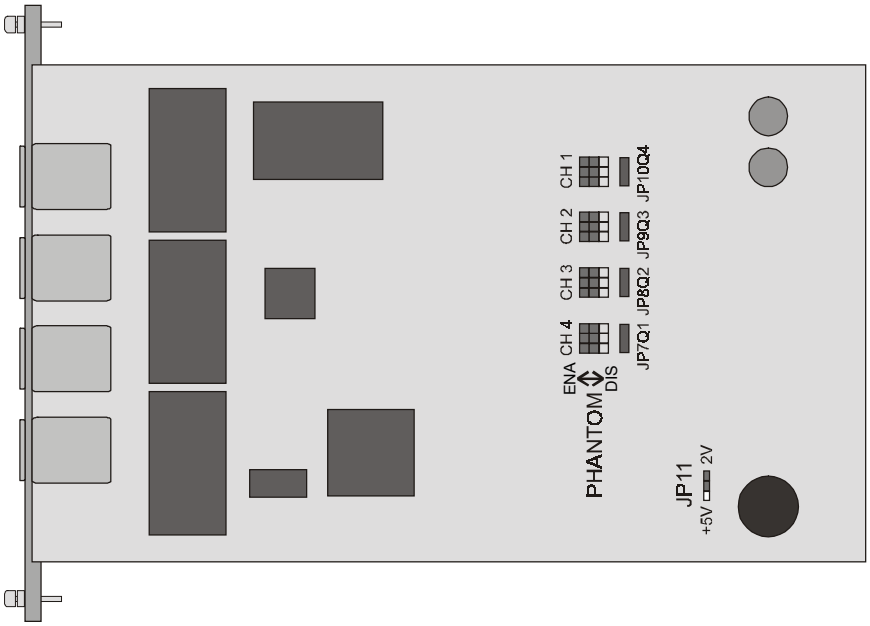


Figure 2-1. The IPmux-1E ISDN-S Jumpers

➤ **After completing the internal settings, reinstall the top cover as follows:**

1. Position the IPmux-1/1E case on a flat, clean surface.
2. Slide the cover into the slots from the rear panel, and set the cover in place.
3. Fasten the cover to the rear panel with the locking spring screws (one is near the POWER connector).

Connecting Interfaces and Cables

Figure 2-2 through *Figure 2-5* illustrate the front and rear panel options available for IPmux-1.

Figure 2-6 through *Figure 2-9* illustrate the rear and front panel options available for IPmux-1E.

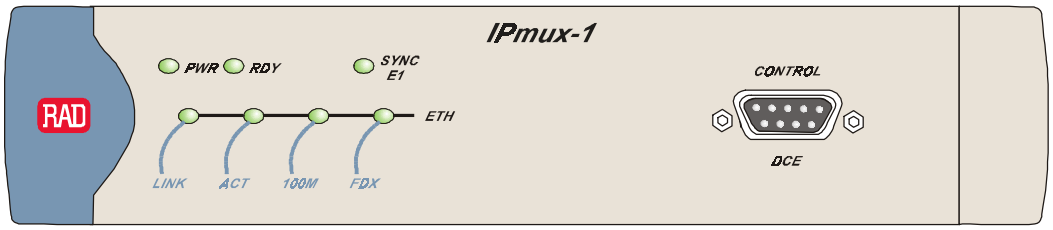
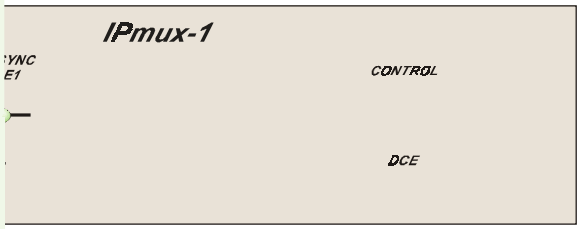


Figure 2-2. IPmux-1 Front Panel


IPmux-1
CONTROL
DCE

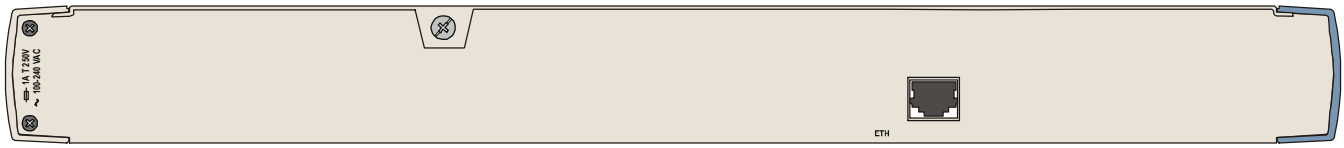

1A T 250V
100-240 VAC
ETH

Table 2-1. E1/T1 Port Connectors Pinout

Pin	Designation	Direction	Function
1	RD (R)	Input	Receive data (ring)
2	RD (T)	Input	Receive data (tip)
3,6	–	–	FGND
4	TD (R)	Output	Transmit data (ring)
5	TD (T)	Output	Transmit data (tip)
7,8	–	N/A	Not connected

Table 2-2. Ethernet Port Pinout

Pin	Pinout
1	Tx+
2	Tx–
3	Rx+
4	–
5	–
6	Rx–
7	–
8	–

Table 2-3. Control Port Pinout

Pin	Pinout
1	–
2	Rx
3	Tx
4	–
5	GND
6	–
7	–
8	–
9	–

Table 2-4. ISDN-S Interface Pin Assignments

Pin Number	Signal Name
3	Tx+
4	Rx+
5	Rx-
6	Tx-

Table 2-5. FXS Interface Pin Assignments for RJ-11

Pin Number	Designation	Direction	Function
1,2			Not connected
3	RING	IN/OUT	2W input/output
4	TIP	IN/OUT	2W input/output
5,6			Not connected

Connecting the Control Port

The Control port is located on the IPmux-1/1E front panel (*Figure 2-2*). The External Clock port pinout is shown in *Figure 2-10* listed in *Table 2-6*.

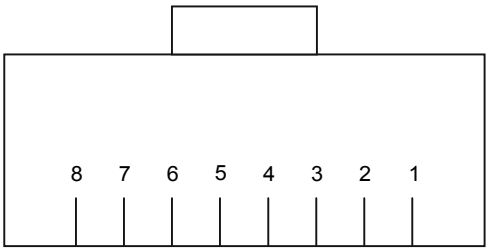


Figure 2-10. External Clock Port Pinout

Table 2-6. External Clock Port Pinout

Pin Number	Signal Name	Function
	RRING	Rx
2	RTIP	Rx
3	GND	Usually not connected
4	TRING	Tx
5	TTIP	Tx
6	GND	Usually not connected
7		Not connected
8		Not connected

Connecting the Power

To connect power to Ipmux-1/1E, refer to the appropriate section below, depending on your version of the unit (AC or DC).

AC Power Connection

AC power is supplied to IPmux-1/1E through the 5-ft (1.5m) standard power cable terminated by a standard 3-prong plug. The cable is supplied with the unit.

➤ **To connect AC power to IPmux-1/1E:**

1. Verify that the AC outlet is grounded properly. Ensure that the supply voltage is in the range 100 VAC to 240 VAC.
2. Check that both Power switches on the rear panel are set to OFF.
3. Connect the power cable to the rear panel connector first and then to the AC mains outlet.

DC Power Connection

A DC power supply option is available to be ordered for IPmux-1 only (not available for IPmux-1E. For information about connecting the DC power supply refer to the *DC Power Supply Connection Supplement* at the back of this manual.

Chapter 3

Operation

This chapter:

- Provides a detailed description of the front panel controls and indicators and their functions
- Explains power-on and power-off procedures
- Provides instructions for using a terminal connected to the IPmux-1/1E Control port
- Describes how to navigate menus
- Illustrates some menus:
  - Main menu
  - Configuration menu
  - Viewing System Information
  - Monitoring IPmux-1/1E performance.

For a detailed explanation of parameters on the menus, see *Appendix E*.

3.1 Front Panel Controls, Connectors, and Indicators

The unit's LEDs (see *Figure 3-1, Figure 3-2, Figure 3-3* and *Figure 3-4)* are located on the left side of the front panel. *Table 3-1* and *Table 3-2* list the functions of the IPmux-1 and IPmux-1E system indicators and switches.

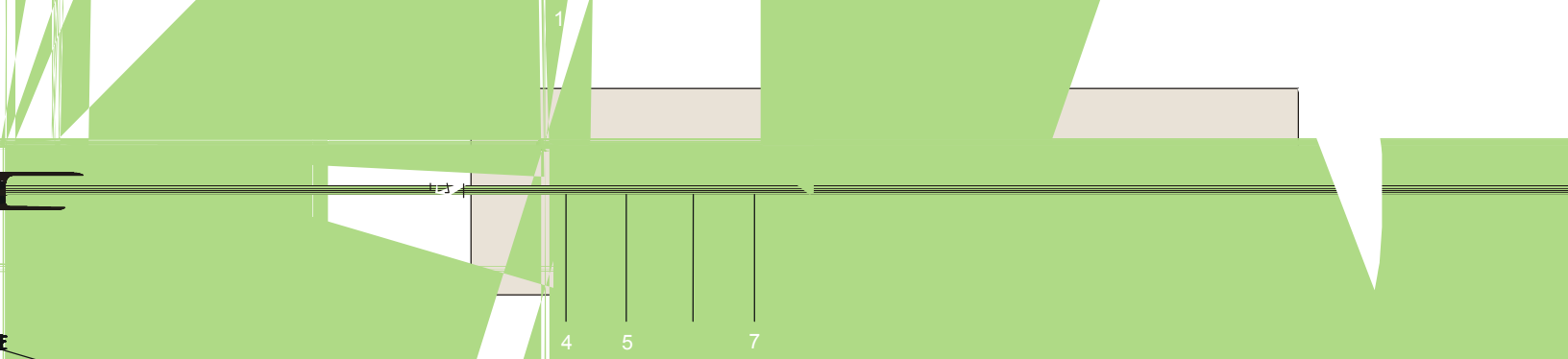


Figure 3-1. IPmux-1 Front Panel LEDs

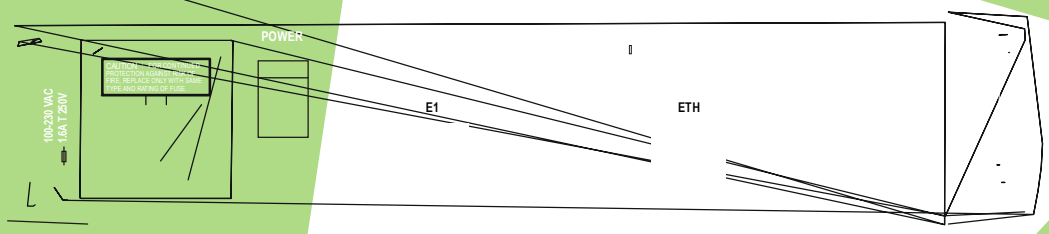


Figure 3-2. IPmux-1 Rear Panel Switch

Table 3-1. IPmux-1 System Indicators and Switches

No.	Name	Type	Function
1	PWR	LED	On: Unit powered Off: Unit not powered
2	RDY	LED	On: Device OK Off: Self-test in progress Blinking: Malfunction detected
3	SYNC E1	LED	On: Port synchronized (no alarm) Off: Unframed: Signal loss or AIS detected Framed: Signal loss, loss of frame or AIS detected Blinking: RDI detected (remote alarm)
4	ETH LINK	LED	On: Line OK Off: Link not active
5	ETH ACT	LED	On: Frame being transferred on line Off: No activity
6	ETH 100M	LED	On: 100 Mbps Off: 10 Mbps

Table 3-1. IPmux-1 System Indicators and Switches (Cont.)

No.	Name	Type	Function
7	ETH FDX	LED	On: Full duplex Off: Half duplex
8	POWER	Switch	Turns IPmux-1/1E power On and Off

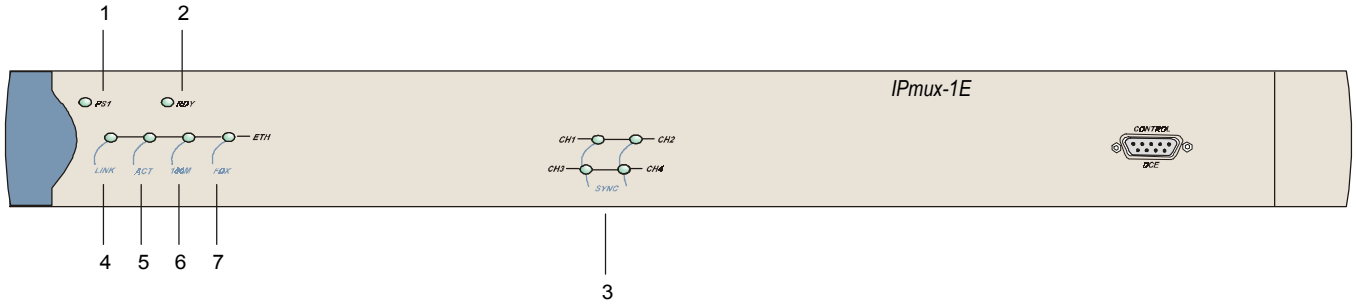


Figure 3-3. IPmux-1E Front Panel Indicators

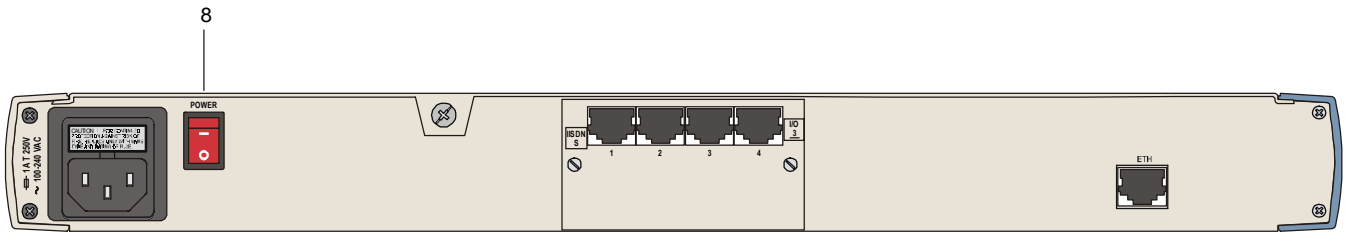


Figure 3-4. IPmux-1E Back Panel Indicators

Table 3-2. IPmux-1E (BRI/FXS) System Indicators and Switches

No.	Name	Type	Function
1	PS1		Green On: Unit powered Red On: Power supply failure Off: Unit not powered
2	RDY	LED	On: Device OK Off: Self-test in progress Blinking: Malfunction detected
3	SYNC CH1–CH4	LED	ISDN On: ISDN synchronized Off: ISDN LOF FXS On: OFF hook Off: ON hook Blinking: Ringing

Table 3-2. IPmux-1E (BRI/FXS) System Indicators and Switches (Cont.)

No.	Name	Type	Function
4	ETH LINK	LED	On: Line OK Off: Link not active
5	ETH ACT	LED	On: Frame being transferred on line Off: No activity
6	ETH 100M	LED	On: 100 Mbps Off: 10 Mbps
7	ETH FDX	LED	On: Full duplex Off: Half duplex
8	POWER	Switch	Turns IPmux-1E power ON and OFF

3.2 Operating Instructions

Turning IPmux-1/1E On

The IPmux-1/1E power switch is located on the back panel, as shown in *Figure 3-2*.

➤

1. Turn the power supply switch, located on the rear panel, to ON.
2. Check the unit LED indicators, located on the left side of the front panel, and the module indicators for proper operation (*see Figure 3-1, Figure 3-2, Figure 3-3, Figure 3-4, Table 3-1,* and *Table 3-2)*.

➤

1. Make sure all IPmux-1/1E cables and connectors are properly connected.
2. Connect IPmux-1/1E to a PC equipped with an ASCII terminal-emulation application (for example, Windows 95 Hyper Terminal or Procomm).
3. Turn on the control-terminal PC and set its default port parameters to 19,200 baud, 8 bits/character, 1 stop bit, No Parity. Set the terminal emulator to ANSI VT100 emulation (for optimal view of system menus).
4. Switch ON the POWER supply switch, located on the rear panel.
5. When the initialization and self-test are over, a menu appears displaying initialization and self-test results. If the self-test is successful, the RDY LED (*Figure 3-1* and *Figure 3-3*) on the left side of the front panel lights. If problems are encountered, refer to *Chapter 4* for instructions.

6. Press to open the configuration software.
7. Enter your User Name according to your assigned system privileges (either Supervisor ( ) or and then your Password when prompted (the factory-set password is).

   The Main Menu is displayed (*Figure 3-8*).

Note *If the password is invalid in three consecutive attempts, the system becomes inaccessible for 15 minutes.*

Login

➤

1. Enter for User Name.
2. Enter for Password.

This allows you to configure all the parameters of Ipmux-1/1E, and to change the *su* and *user* passwords.

➤

1. Enter for User Name.
2. Enter for Password.

This does not allow you to make configuration changes.

➤):

- Delete the unit's configuration through the Configuration screens.

Note *Deleting the unit's configuration using <**Cntl+A**> and choosing **4** in the Boot Menu does not set the password to the default value.*

➤

- Consult Technical Support at RAD for further assistance (send email to support@rad.co.il).

Turning IPmux-1/1E Off

➤

- Switch PWR to OFF.

3.3 Getting Started

After installation, there are no special operating procedures for IPmux-1/1E. Once it is powered up, the unit operates automatically. The front panel LED indicators (*Figure 3-1* and *Figure 3-3*) indicate proper operation. The unit operational status can be monitored constantly.

If required, IPmux-1/1E can be reconfigured. Both the IPmux-1/1E configuration and monitoring operations are performed locally from an ASCII terminal connected to the Control port. Detailed configuration procedures are given in *Overview of Menu Operations and Appendix E*.

The following functions are supported (see menu trees in *Figure 3-5*, *Figure 3-6*, and *Figure 3-7*):

- Viewing system information
- Modifying configuration and mode of operation, including setting system default values
- Viewing statistics and status
- Performing diagnostics.

3.4 Overview of Menu Operations

Navigating

Navigate the IPmux-1/1E terminal menus to set and view configuration parameters:

- *Figure 3-5* maps the IPmux-1 terminal menus
- *Figure 3-6* maps the IPmux-1E ISDN-S terminal menus
- *Figure 3-7* maps the IPmux-1E FXS terminal menus.

Use these menu trees as a reference aid while performing configuration and control functions. *Appendix E* illustrates menus, explains parameters, and lists default values. Refer to *Appendix E* to find specific parameters.

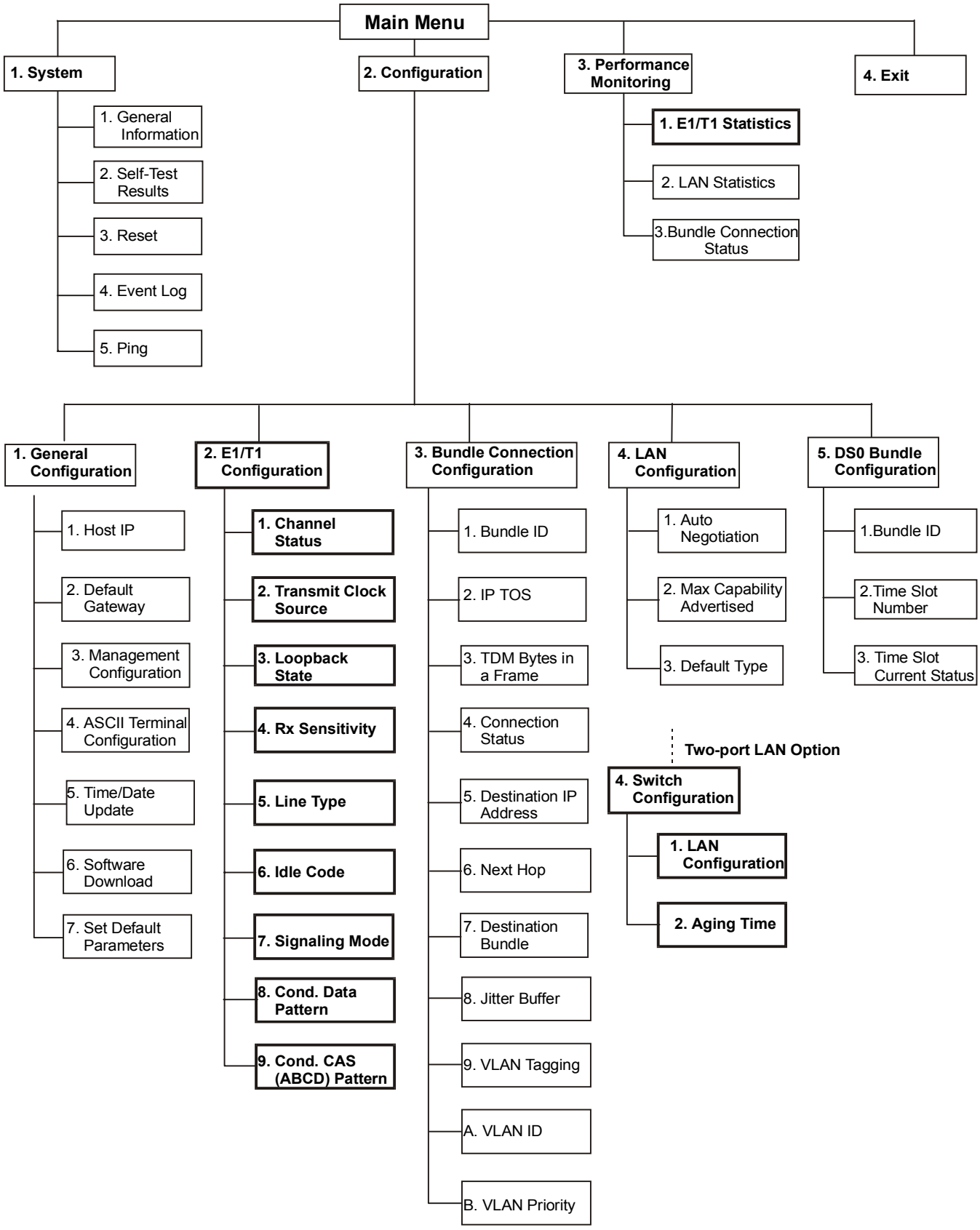


Figure 3-5. IPmux-1 (E1/T1) Terminal Menu Tree

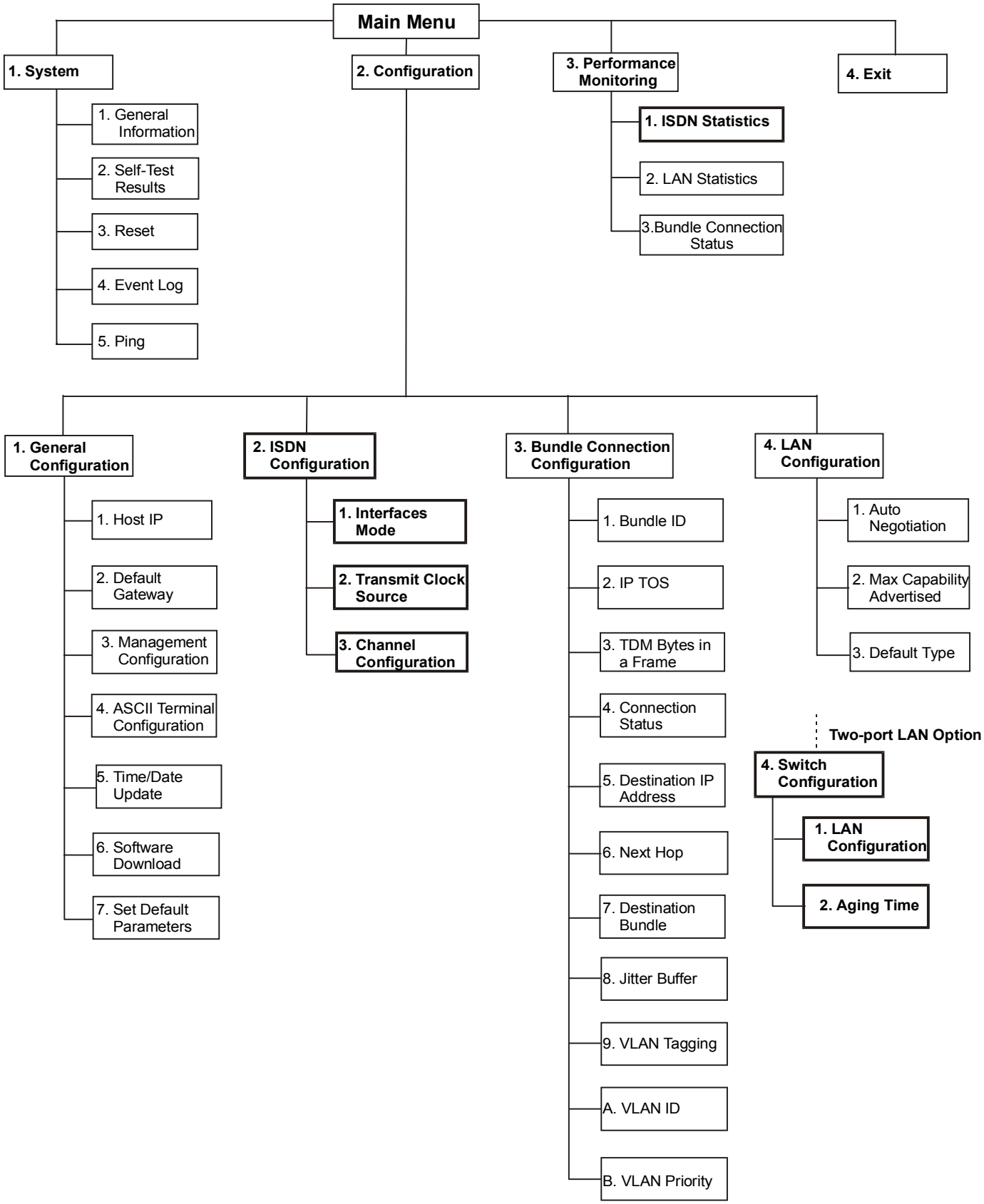


Figure 3-6. IPmux-1E ISDN-S Terminal Menu Tree

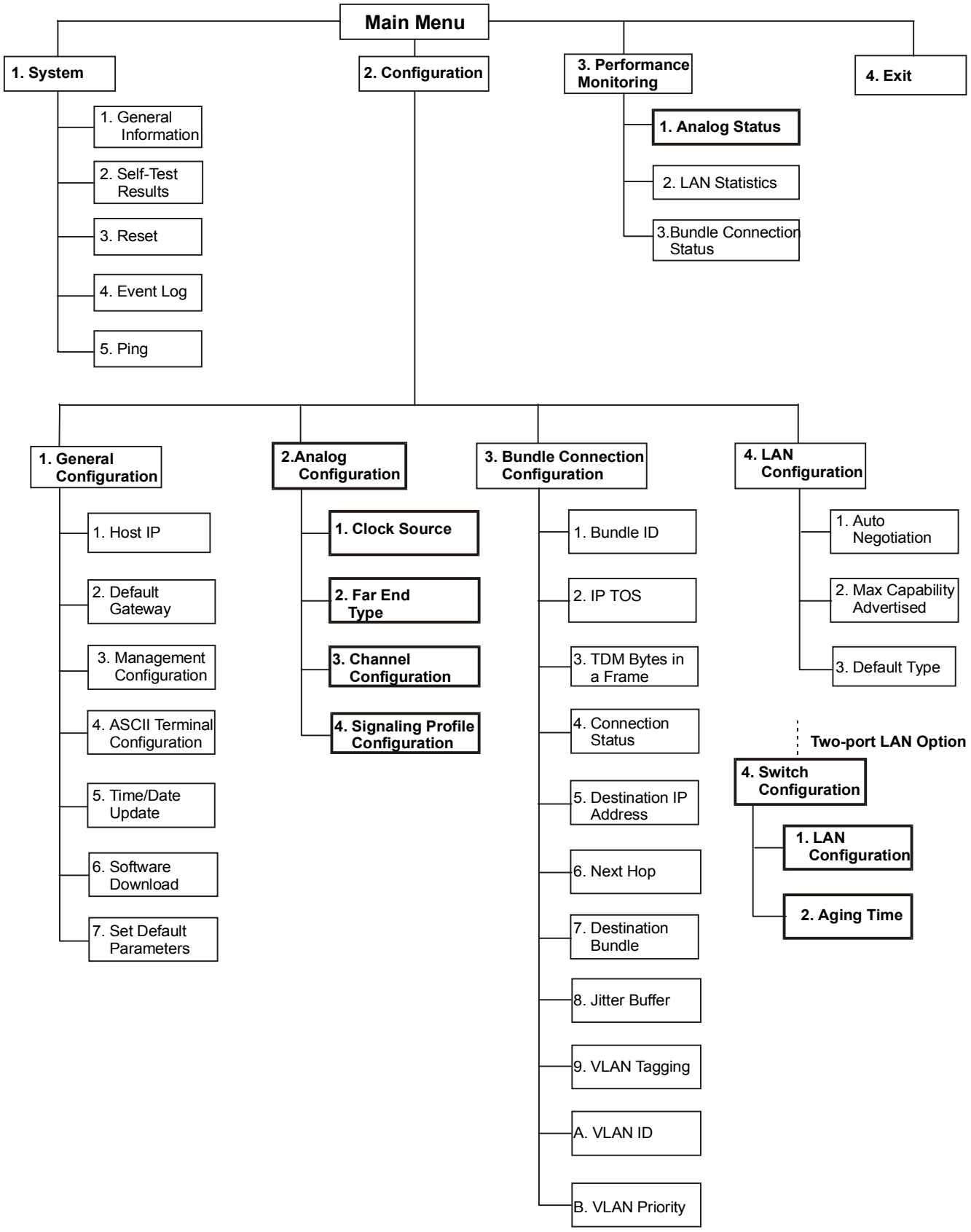


Figure 3-7. IPmux-1E FXS Terminal Menu Tree

Main Menu

Figure 3-8 shows the IPmux-1/1E Main Menu. Access all system configuration and control functions via this menu.

At any point and from any screen, you can press repeatedly, backing up until you reach the main menu.

You exit the program only from this menu. In order to prevent unauthorized access, it is recommended that when you finish a session, you return to the Main Menu and type to exit the program. A password is then required for reentry.

```
                          MAIN MENU
1.System                                  >
2.Configuration                           >
3.Performance Monitoring                  >
4.Exit

Select item from the menu:                _
Use keys <1> to <4>
```

Figure 3-8. IPmux-1/1E Main Menu

The Main Menu options are:

- . View and modify system parameters
- . Define system configuration
- . Monitor system performance
- . Exit the control software

System Menu

➤

Main Menu
↓

- Type (System) in the .

From the System menu you can view and configure the following options:

- . View IPmux-1/1E general information.
- . Review self-test results obtained during system power-up.
- . Reset IPmux-1/1E.
- . View a list of IPmux-1/1E events.
- . Ping other network devices.

These options are explained in full detail in *Appendix E*.

```
                              SYSTEM
1. General Information
2. Self-Test Results
3. Reset
4. Event Log  >
5. Ping

ESC.  Exit

Select item from the menu.
```

```
                    CONFIGURATION
1. General Configuration
2. Analog Configuration
3. Bundle Connection Configuration
4. LAN Configuration
ESC. Exit

Select item from the menu:                    _
```

Figure 3-12. IPmux-1E FXS Configuration Menu

From the Configuration menu you can view and configure the following options:

Configure Host IP, Default Gateway, ASCII Terminal Configuration, Time/Date update, and Default parameters, and download software updates.

E1/T1, ISDN, or FXS physical layer configuration.

Configure Connection parameters: Configure IP ToS, TDM bytes/frame and VLAN tagging.

Ethernet physical layer configuration.

Configure TS assignment to the bundle (only for IPmux-1).

Specific parameters are explained in *Appendix E*.

Note *DS0 Bundle Configuration is only available in IPmux-1.*

Performance Monitoring

➤

- Type (Performance Monitoring) in the menu.

Typical menus are shown in *Figure 3-13*, *Figure 3-14*, and *Figure 3-15*.

```
                    PERFORMANCE MONITORING


1. E1/T1 Statistics
2. LAN Statistics
3. Bundle Connection Status
ESC. Exit
Select item from the menu.
```

Figure 3-13. Performance Monitoring Menu for IPmux-1

```
                    PERFORMANCE MONITORING


1. ISDN Statistics
2. LAN Statistics
3. Bundle Connection Status
ESC. Exit
Select item from the menu.
```

Figure 3-14. Performance Monitoring Menu for IPmux-1E ISDN-S

```
                    PERFORMANCE MONITORING


1. FXS Statistics
2. LAN Statistics
3. Bundle Connection Status
ESC. Exit
Select item from the menu.
```

Figure 3-15. Performance Monitoring Menu for IPmux-1E FXS

From the Performance Monitoring menu you can view:

Statistics for E1/T1, ISDN, or FXS.

Further details for specific parameters are explained in *Appendix E*.

Chapter 4

Troubleshooting and Diagnostics

This chapter describes how to:

- Detect errors
- Troubleshoot problems
- Perform diagnostic tests.

4.1 Error Detection

Using Front Panel LEDs

LED indicators on the front panel IPmux-1/1E indicate the operating status of the module. The LED indicators are described in *Chapter 3* of this manual.

Working with the Alarm Buffer

IPmux-1/1E maintains an Event Log File. All events are time-stamped. The user can view the contents of the Event Log File via an ASCII terminal or a Telnet Session. The user can also clear the contents of the Log File.

Table 4-1 presents the event types that appear on the Event Log File alphabetically, as well as the actions required to correct the event (alarm) indication.

To correct the reported problem, perform corrective actions in the given order until the problem is corrected. If the problem cannot be fixed by carrying out the listed actions, IPmux-1/1E **MUST** be checked by the **authorized** technical support personnel.

Table 4-1. Event Types

Event	Description	Corrective Action
COLD_START	The IPmux-1/1E has been powered up	None
PWR_ACTIVE	IPmux-1/1E power supply unit is powered on	None
FATAL ERR	IPmux-1/1E has encountered an internal fatal error	The IPmux-1 requires servicing
SYS USER RESET	IPmux-1/1E was reset by the user	None
LOS START	IPmux-1 has a LOS (loss of signal) state on its E1/T1 port	1. Check the port cable connection 2. Check input signal
LOS END	The LOS state detected has ended	
LOF START	IPmux-1 has a LOF (Loss of frame synchronization) state on its E1/T1 port	1. Check port cable connection 2. Check input signal
LOF END	The LOF state detected has ended	None
LINE AIS START	IPmux-1 has AIS (alarm indicator signal) state on its E1/T1 port	Check for a fault at the PDH network, on the receive direction
LINE AIS END	The line AIS state detected has ended	None
LINE RDI START	IPmux-1 has LINE RDI (remote defect indicator) state on its E1/T1 port	Check for a fault at the E1/T1 connectivity on the transmit direction
LINE RDI END	The LINE RDI state detected has ended	None
LINE FEBE START	IPmux-1 has LINE FEBE state on its E1/T1 port	Check for errors in the E1/T1 connection on the transmit direction
LINE FEBE END	The LINE FEBE state detected has ended	None
REMOTE FAIL START	Ethernet frames are not received by the remote IPmux-1 on the specified connection	Check Eth/IP path
REMOTE FAIL END	Remote fail state has ended	None
LOCAL FAIL START	Ethernet frames are not received by the local IPmux-1 on the specified connection	Check Eth/IP path
LOCAL FAIL END	Local fail state has ended	None

4.2 Troubleshooting

Table 4-2 presents the event types as they appear on the Event Log File and lists the actions required to correct the event (alarm) indication.

Table 4-2. IPmux-1 Troubleshooting Chart

Fault	Probable Cause	Remedial Action
E1/T1 equipment connected to IPmux-1 is not synchronized with IPmux-1/1E.	Configuration problems Physical layer problems	1. Check cables and physical connectivity. 2. Check IPmux-1 E1/T1 configuration and, if necessary, other IPmux-1 parameters. 3. Check E1/T1 physical connection (use loopbacks).
Slips and errors in E1/T1/BRI/FXS equipment	• Ethernet port in switch and IPmux-1 are not in the same rate or duplex mode • Ethernet port is set to work in half duplex mode (may cause extreme PDV because of collisions and backoffs) • Timing configuration is not properly set (periodic buffer under/overflows shown on IP channel status menu) • Deactivation employed by NT when IPmux is TE and in loopback timing mode • Network PDV or lost frames	1. Check E1/T1 physical connection (use loopbacks). 2. Check timing settings according to explanation in this manual. 3. Check switch and IPmux-1 port configuration (negotiation, rate, duplex mode) 4. Check PDV introduced by the network, and, if necessary, increase PDVT jitter buffer setting. 5. Check NT deactivation (BRI).
Echo in voice	High delay in voice path	1. Check network delay and try to decrease it. 2. Try to decrease PDVT (jitter) buffer.

4.3 Diagnostic Tests

Maintenance capabilities include external and internal loopbacks.

E1/T1

External Loop

IPmux-1 can be set to an external loop to test the connection between the E1/T1 port and the PBX (refer to *Chapter 3*). In this mode, data coming from the PBX is both looped back to the PBX and transmitted forward to the IP network (see *Figure 4-1*).

This mode can also be achieved by a T1 FDL line loopback command.

Figure 4-1. IPmux-1 External Loop

Internal Loop

The E1/T1 module can be set to an internal loop to test the connection between the E1/T1 port and the IP network (refer to *Chapter 3*). In this mode (E1/T1 only), data coming from the IP network is both looped back to the IP network and an AIS pattern is transmitted forward to the PBX connected to the E1/T1 port (see *Figure 4-2*).

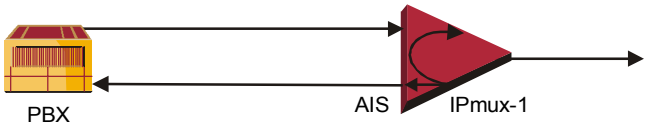


Figure 4-2. IPmux-1 Internal Loop

➤ **To run a loopback test:**

- Press the **<Spacebar>**

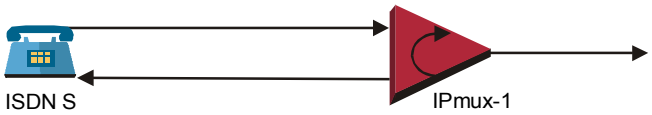


Figure 4-4. IPmux-1E/BRI Internal Loop

Main Menu
↓
2. Configuration
↓
2. ISDN Configuration
↓
3. Channel Configuration
↓
1. Choose Channel
↓
3. Loopback State

➤ **To run a loopback test:**

- Press the **<Spacebar>** on your keyboard to toggle between the values: **Internal/External /Disable**.
  - Internal: Data received from the IP network side is looped back to the network transmit line.
  - External: Data received from the PBX at the receive ISDN S line is looped back to the ISDN S Tx path (toward the same PBX). Data coming from the IP network is ignored.
  - Disable: No loopback. Regular operation.

Default value: **Disable**

FXS

Main Menu
↓
2. Configuration
↓
2. ISDN Configuration
↓
3. Channel Configuration
↓
1. Choose Channel
↓
5. Testing

Remote Loopback

You can set a remote loopback analog signal, per port, in IPmux-1E with FXS interface. The analog signal is looped back towards the IP network.

Tone Injection

A 1 kHz tone, per port, is injected towards the local telephone set.

➤ **To run a test:**

- Press the **<Spacebar>** on your keyboard to toggle between the values: **Remote Loopback/Tone Injection/Disable**.

Default value: **Disable**

Chapter 5

Application Configuration Procedures

This chapter provides detailed instructions for setting up a test application using IPmux-1 and IPmux-4. The application can be used as an optional test setup for an IPmux unit, or can be used as a quick reference guide for basic configuration of an IPmux unit.

5.1 Overview

Application

The section provides detailed instructions for configuring an IPmux-1 unit opposite an IPmux-4 unit in a point-to-multipoint application including configuration via a supervisory terminal (see *Figure 5-1*).

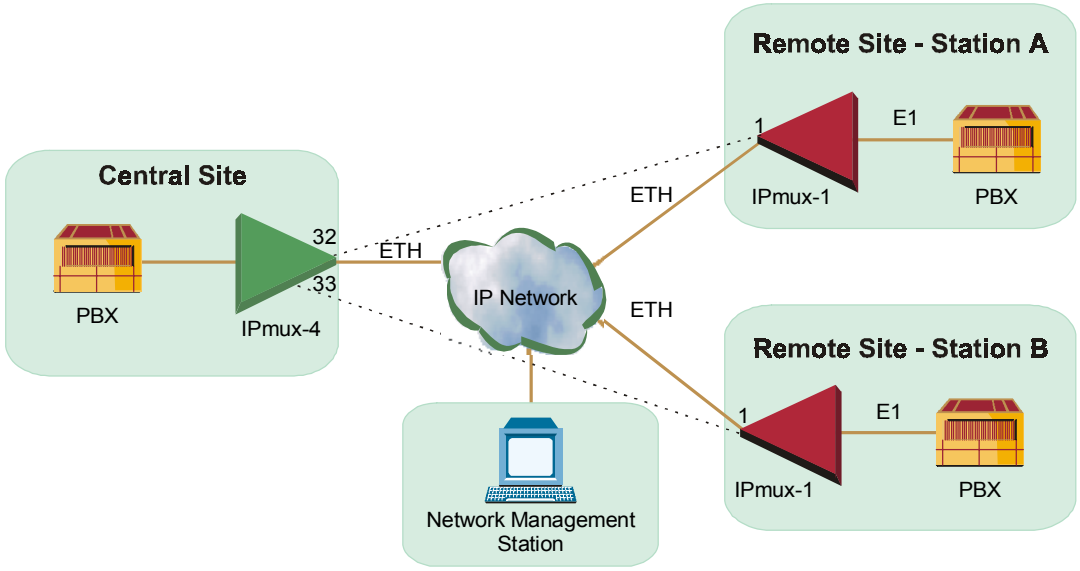


Figure 5-1. IPmux-1 Operating Opposite IPmux-4

Guidelines

Certain guidelines/assumptions for configuring IPmux-1 working opposite IPmux-4 that are relevant to this application are explained below.

IP Configuration

- The IP network can consist of either switches or routers. The minimum requirement is 10M full duplex. Hubs or any half-duplex environments should not be used.
- Each IPmux should be given an IP Address and a Default Gateway (if a routed network is used).

E1/T1 Configuration

- TDM traffic will be sent between the central IPmux-4 and the two remote IPmux-1 units at Station A and Station B over the IP network.
- The TDM traffic can either be generated by a BER tester connected to the IPmux units or by a PABX. If a BER tester is connected to IPmux-4, a physical loop can be inserted in the remote IPmux-1 E1 port to avoid using more BER testers.
- The TDM equipment connected to the central IPmux-4 should be the clock source for the whole application (i.e. it will operate in internal mode). The two other TDM devices connected to IPmux-1 receive the clock from the Tx path of the IPmux-1 units.
- Set the TDM device's E1 parameters in accordance with the E1 parameters of the IPmux units connected to them. For details, see *Table 5-1*and *Table 5-2*, and the E1/T1 Configuration on the following pages.
- On the IPmux-4, only E1 port 2 will be used to connect to the remote IPmux-1 units.

Creating Bundles and Connections

- After IP addresses and E1 parameters have been configured, create bundles on each IPmux, followed by connections between the bundles.
- A bundle is a group of timeslots, encapsulated in UDP over IP over ETH frames, which is sent over the IP network between the IPmux units. A bundle can include between 1 and 31 timeslots for E1, and 1 to 24 for T1. IPmux-1 can only be configured for 1 bundle. IPmux-4 can be configured to have up to 31x4=124 bundles for E1 or 4x24=96 for T1. Each configured bundle is given a Bundle Number that indicates to which E1 channel it belongs, according to *Table 5-1*.

Table 5-1. Bundle Configuration

E1 Channel	Bundle Number for E1	Bundle Number for T1
1	1-31	1–24
2	32-62	25–48
3	63–93	49–72
4	94–124	73–96

- A bundle containing 10 timeslots will be created on each IPmux-1 unit. Two bundles, each containing 10 timeslots, will be created on IPmux-4.
- Bundle 1 on IPmux-1/Station A will be connected to Bundle 32 on IPmux-4. Bundle 1 on IPmux-1/Station B will be connected to Bundle 33 on the central IPmux-4.

Configuration Summary Table

Table 5-2. Configuration Summary

Device	E1 Parameters	Bundle Creation	Bundle Connection
IPmux-1/A	Clock: Adaptive CRC: Disabled CAS: Disabled	Bundle No. 1 Timeslots in Bundle: 1–10	1→IPmux-4/32
IPmux-1/B	Clock: Adaptive CRC: Disabled CAS: Disabled	Bundle No. 1 Timeslots in Bundle: 1–10	1→IPmux-4/33
IPmux-4	Clock: Loopback CRC: Disabled CAS: Disabled	Bundle No. 32 Timeslots in Bundle: 1–10 Bundle No. 33 Timeslots in Bundle: 11–20	32→IPmux-1/A 33→IPmux-1/B

Perform initial configuration of IPmux-1 and IPmux-4 via a standard ASCII terminal connected to the IPmux-1 control port. However, after performing the initial configuration (Host IP Address and Default Gateway), you can manage IPmux-1 and IPmux-4 using any of the following options:

- Use the terminal as a supervisory terminal, for performing all the management activities supported by IPmux-1/4
- Manage IPmux-1/4 from any IP host using the Telnet protocol. After establishing a Telnet session with IPmux-1, the Telnet protocol offers the same functionality as the supervisory terminal, and in addition enables remote access over IP networks.

- Manage IPmux-1/4 by means of SNMP-based network management stations, e.g., the RADview network management station offered by RAD.

Changing Parameters

- Use the <**Spacebar>** on your keyboard to toggle between options in the menus, and then save.
- Press <**Enter**> after entering a new parameter, such as the IP address, and then save by pressing **S**.
- At any point and from any screen, you can press <**Esc**> repeatedly, backing up until you reach the Main menu.

Checking Connectivity

After the configuration has been completed, several tests should be performed in order to verify proper connectivity. For testing procedures see *Section 5.5*.

5.2 IPmux-1

Powering-up

➤ **To turn on IPmux-1:**

1. Make sure all IPmux-1 cables and connectors are properly connected.
2. Connect IPmux-1 to a PC equipped with an ASCII terminal-emulation application (for example, Windows 95 Hyper Terminal or Procomm).
3. Turn on the control-terminal PC and set its default port parameters to **19,200 baud, 8 bits/character, No Parity, 1 stop bit.**
4. Set the terminal emulator to **ANSI VT100** emulation (for optimal view of system menus).
5. Switch ON the POWER supply switch, located on the rear panel.

   When the initialization and self-test are over, a menu appears displaying initialization and self-test results. If the self-test is successful, the **RDY LED** on the left side of the front panel lights up.

➤ **To logon:**

1. Press **<Esc>** to open the configuration software.
2. Enter your User Name as Supervisor (**su**) and press <**Enter**>.
3. Enter your Password (the factory-set password is **xxxxxxxxxx**).

Note *If the password is invalid in three consecutive attempts, the system becomes inaccessible for 15 minutes.*

Configuring IPmux-1 – Station A

Procedure for Modifying Parameters

➤ **To modify parameters:**

1. Choose the number of the parameter to be changed.
2. Press the <**Spacebar**> to toggle through the possible values.
3. Select the desired value by pressing <**Enter**>.
4. When you have finished modifying all the parameters on a menu, press <**S**> to save the configuration.
5. To return to a previous menu, press <**Esc**>.

Host IP Address

Note *Frames will not leave the device until IP and Mask addresses are defined.*

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
1. Host IP

➤ **To configure the Host IP Address:**

1. From the **Main** menu, select **2 Configuration.**
2. From the Configuration menu select 1 General Configuration.
3. From the **General Configuration** menu, press **1 Host IP** (see *Figure 5-2*)**.**
4. Enter the Host IP Address and Mask.
5. Press <**Esc**> a few times back to the **General Configuration** menu.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

```
                                    HOST IP
1. IP Address                 192.168.100.11
2. IP Mask                    255.255.255.0
ESC. Exit               S.Save

Select item from the menu.
```

Figure 5-2. Host IP Menu

E1/T1 Configuration

➤ **To configure E1/T1:**

Main Menu
↓
2. Configuration
↓
2. E1/T1 Configuration

1. From the **Main** menu, select **2 Configuration.**
2. From the **Configuration** menu select **2 E1/T1 Configuration** (see *Figure 5-3*)**.**
3. Select Transmit Clock and choose Adaptive.
4. Select Line Type and choose CRC4 Disable.
5. Select Signaling Mode and choose CAS Disable.
6. Press <**S**> to save the configuration.
7. Press <**Esc**> a number of times to return to the **Configuration** screen.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

```
                          E1/T1 CONFIGURATION
1. Channel Status           Enable
2. Transmit Clock Source    Adaptive
3. Loopback State           Disable
4. Rx. Sensitivity          -10dB
5. Line Type                CRC4 Disable
6. Idle Code                7E
7. Signaling Mode           CAS Disable
8. Cond. Data pattern       FF
9. Cond. Cas <ABCD> pattern 01

ESC. Exit
Select item from the menu.
```

Figure 5-3. E1/T1 Configuration Menu

DS0 Bundle Configuration

➤ **To create the bundles:**

Main Menu
↓
2. Configuration
↓
5. DS0 Bundle Configuration

1. From the **Configuration** menu select **5 DS0 Bundle Configuration** (see *Figure 5-4*).
2. Select Time slot number and enter 1 – 10.
3. Select Time slot Current Status and choose Set.
4. Press <**S**> to Save.
5. Press <**Esc**> to return to the **Configuration** screen.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

```
                          DS0 BUNDLE CONFIGURATION
1. Bundle ID                          1
2. Time Slot Number                   1-10
3. Time Slot Current Status           Set


ESC. Exit


ACTIVE TIME SLOTS IN THIS BUNDLE:   1-10
FREE TIME SLOTS:       11,12,13,14,15,
                       16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31
Select item from the menu.
```

Figure 5-4. DS0 Bundle Configuration Menu

Bundle Connection Configuration

➤ **To link the bundles to IPmux-4:**

Main Menu
↓
2. Configuration
↓
3. Bundle Connection Configuration

1. From the **Configuration** menu select **3 Bundle Connection Configuration** (see *Figure 5-5*).
2. Select Connection Status and choose Enable.
3. Select **Destination IP Address** and enter the IP Address of IPmux-4.
4. Select **Next Hop** and enter the next hop router IP address (this parameter is only necessary if the Destination IP Address is not in the same subnet as this IPmux. In such cases the Ethernet frame will be sent to the next hop IP address).
5. Select **Destination Bundle** and enter **32** (which is the destination bundle on IPmux-4)**.**
6. Press <**Esc**> a few times to return to the **Main** menu.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

```
                    BUNDLE CONNECTION CONFIGURATION
1. Bundle ID                                              1
2. IP TOS                                                 Empty!
3. TDM Bytes in Frame                                     48
4. Connection Status                                      Empty!
5. Destination IP Address                                 192.168.200.10
6. Next Hop                                               Empty!
7. Destination Bundle                                     Empty!
8. Jitter Buffer<x10 µsec> rounded up 1000 µsec steps!    3 ms
9. VLAN Tagging                                           Empty!
10. VLAN ID                                               Empty!
11. VLAN Priority                                         Empty!

ESC. Exit
Select item from the menu.
```

Figure 5-5. Bundle Connection Configuration

Note ***TDM Bytes in Frame*** *and* ***Jitter Buffer*** *are automatically set to default values: 48 for TDM Bytes, 3 ms for Jitter Buffer.*

Configuring IPmux-1 – Station B

Power-up in the same manner as for IPmux-1 Station A.

Host IP Address

Note *Frames will not leave the device until IP and Mask addresses are defined.*

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
1. Host IP

➤ **To configure the Host IP Address:**

1. From the **Main** menu, select **2 Configuration.**
2. From the **Configuration** menu select **1 General Configuration.**
3. From the **General Configuration** menu, press **1 Host IP** (refer to *Figure 5-2)*.
4. Enter the **Host IP Address** and **Mask**.
5. Press <**Esc**> a few times back to the **General Configuration** menu.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

E1/T1 Configuration

➤ **To configure E1/T1:**

Main Menu
↓
2. Configuration
↓
2. E1/T1 Configuration

1. From the **Main** menu, select **2 Configuration.**
2. From the **Configuration** menu select **2 E1/T1 Configuration** (refer to *Figure 5-3)*.
3. Select Transmit Clock and choose Adaptive.
4. Select Line Type and choose CRC4 Disable.
5. Select Signaling Mode and choose CAS Disable.
6. Press <**S**> to save the configuration.
7. Press <**Esc**> a number of times to return to the **Configuration** screen.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

DS0 Bundle Configuration

➤ **To create the bundles:**

Main Menu
↓
2. Configuration
↓
5. DS0 Bundle Configuration

1. From the Configuration menu select **5 DS0 Bundle Configuration** (refer to *Figure 5-4)*.
2. Select Time slot number and enter 1 – 10.
3. Select Time slot Current Status and choose Set.
4. Press <**S**> to Save.
5. Press <**Esc**> to return to the **Configuration** screen.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

Bundle Connection Configuration

➤ **To link the bundles to IPmux-4:**

Main Menu
↓
2. Configuration
↓
3. Bundle Connection Configuration

1. From the Configuration menu select **3 Bundle Connection Configuration** (refer to *Figure 5-5)*.
2. Select Connection Status and choose Enable.
3. Select **Destination IP Address** and enter the IP Address of IPmux-4.

4. Select **Next Hop** and enter the next hop router IP address (this parameter is only necessary if the Destination IP Address is not in the same subnet as this IPmux. In such cases the Ethernet frame will be sent to the next hop IP address).
5. Select **Destination Bundle** and enter **33** (which is the destination bundle on IPmux-4)**.**
6. Press <**Esc**> to return to the **Bundle Connection Configuration** screen.
7. Press <**Esc**> to return to the **Main** screen.

*Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

5.3 IPmux-4

Powering-up

➤ **To turn on IPmux-4:**

1. Make sure all IPmux-4 cables and connectors are properly connected.
2. Connect IPmux-4 to a PC equipped with an ASCII terminal-emulation application (for example, Windows 95 Hyper Terminal or Procomm).
3. Turn on the control-terminal PC and set its default port parameters to **19,200 baud, 8 bits/character, No Parity, 1 stop bit.**
4. Set the terminal emulator to **ANSI VT100** emulation (for optimal view of system menus).
5. Switch ON the POWER supply switch, located on the rear panel.
6. When the initialization and self-test are over, a menu appears displaying initialization and self-test results. If the self-test is successful, the **RDY LED** on the left side of the front panel lights up.

➤ **To logon:**

1. Press **<Esc>** to open the configuration software.
2. Enter your User Name as Supervisor (**su**) and press <**Enter**>.
3. Enter your Password (the factory-set password is **xxxxxxxxxx**).

Configuration

Host IP Address

Note *Frames will not leave the device until IP and Mask addresses are defined.*

➤ **To configure Host IP Address:**

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
1. Host IP

1. From the **Main** menu, select **2 Configuration.**
2. From the **Configuration** menu select **1 General Configuration** (refer to *Figure 5-2)*.
3. From the **General Configuration** menu, press **1**.
4. Enter the Host IP Address and Mask.
5. Press <**Esc**> a few times back to the **General Configuration** menu.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

E1/T1 Configuration

➤ **To configure E1/T1:**

Main Menu
↓
2. Configuration
↓
3. E1/T1 Configuration
↓
2. Channel Number Configuration
↓
1. **Physical Layer Configuration**

1. From the Configuration menu select 3 E1/T1 Configuration.
2. The Channel Number Configuration menu appears, press 2 (to choose Channel Number 2).
3. The E1/T1 Configuration menu appears, press 1 Physical Layer Configuration (see *Figure 5-6*).
4. Select Transmit Clock Source and chose Loopback.
5. Select Channel Type and choose CRC4 Disable.
6. Select Signaling Mode and choose CAS Disable.
7. Press <Save>.
8. Press <Esc> to exit the Physical Layer Configuration menu and return to the E1/T1 Configuration menu.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

```
                        PHYSICAL LAYER CONFIGURATION
1. Channel Status            Enable
2. Transmit Clock Source     Loopback
3. Loopback State            Disable
4. Rx. Sensitivity           -10dB
5. Channel Type              CRC4 Disable
6. Idle Code                 7E
7. Signaling Mode            CAS Disable
8. Cond. Data pattern        FF
9. Cond. CAS (ABCD) pattern  01

ESC. Exit

Current port is the USER PORT, Channel #2
Select item from the menu.
```

Figure 5-6. Physical Layer Configuration Menu

DS0 Bundle Configuration

➤ **To configure DS0 Bundles for Station A:**

Main Menu
↓
2. Configuration
↓
2. DS0 Bundle Configuration

1. From the **Configuration** menu select **2 DS0 Bundle Configuration** (refer to *Figure 5-4*).
2. From the **DS0 Bundle Configuration** menu, press **1**.
3. Select **Bundle ID** and type **32**.
4. Select Time slot number type 1–10.
5. Select Time slot Current Status and choose SET.
6. Press <**S**> to Save.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

➤ **To configure DS0 Bundles for Station B:**

1. From the **DS0 Bundle Configuration** menu, press **1** (refer to *Figure 5-4*).
2. Select **Bundle ID** and type **33**.
3. Select Time slot number type 11–20.
4. Select Time slot Current Status and choose SET.
5. Press <**S**> to Save.
6. Press <**Esc**> to return to the **Configuration** menu.

Note

*Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

Bundle Connection Configuration

Main Menu ➤
↓
2. Configuration
↓
5. Bundle Connection Configuration

To link the bundles to IPmux-1 Station A:

1. From the **Configuration** menu select **5 Bundle Connection Configuration** (see *Figure 5-7)*.
2. Select **Bundle ID** and enter **32**.
3. Select Connection Status and choose Enable.
4. Select **Destination IP Address** and enter the IP Address of IPmux-1 Station A.
5. Select **Next Hop** and enter the next hop router IP address (this parameter is only necessary if the Destination IP Address is not in the same subnet as this IPmux. In such cases the Ethernet frame will be sent to the next hop IP address).
6. Select **Destination Bundle** and enter **1** (which is the destination bundle on IPmux-1 Station A)**.**
7. Press **<S>** to save the configuration.
8. Press <**Esc**> to return to the **Bundle Connection Configuration** screen.

Note

1. *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*
2. ***TDM Bytes in Frame** and **Jitter Buffer** are automatically set to default values: 48 for TDM Bytes, 3 ms for Jitter Buffer.*

Main Menu ➤
↓
2. Configuration
↓
5. Bundle Connection Configuration

To link the bundles to IPmux-1 Station B:

1. From the **Configuration** menu select **5 Bundle Connection Configuration** (see *Figure 5-7)***.**
2. Select **Bundle ID** and enter **33**.
3. Select Connection Status and choose **Enable**.
4. Select **Destination IP Address** and enter the IP Address of IPmux-1 Station B.
5. Select **Next Hop** and enter the next hop router IP address (this parameter is only necessary if the Destination IP Address is not in the same subnet as this IPmux. In such cases the Ethernet frame will be sent to the next hop IP address).
6. Select **Destination Bundle** and enter **1** (which is the destination bundle on IPmux-1 Station B)**.**
7. Press **<S>** to save the configuration.

8. Press <**Esc**> a few times to return to the **Main** menu.

Note

1. *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*
2. ***TDM Bytes in Frame** and **Jitter Buffer** have been automatically set to default values: 48 for TDM Bytes, 3 ms for Jitter Buffer.*

```
                    BUNDLE CONNECTION CONFIGURATION


1. Bundle ID                32
2. Connection State         Enable
3. Destination IP Address   192.168.10.1
4. Next Hop                 0.0.0.0
5. Destination Bundle       1
6. Jitter Buffer(x10usec)   300

ESC. Exit                   D. Delete                N. Next

Select item from the menu.                           Total used bundles: 1
```

Figure 5-7. Bundle Connection Configuration in IPmux-4

5.4 Configuring the Management Option

To configure this application for RADview or an SMNP management station perform the following steps on each station of IPmux-1 and IPmux-4.

Authentication/Community

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
3. Management Configuration
↓
1. **Authentication/ Community**

➤ **To configure Authentication/Community:**

1. From the **Management Configuration** menu, press **1 Authentication/Community** menu (see *Figure 5-8*).
2. Select Authentication Failure Trap and choose On.
3. Select **Trap** and choose **Public**.
4. Select **Read** and choose **Public**.
5. Select **Write** and choose **Public**.
6. Press <**S**> to save the configuration.
7. Press <**Esc**> to return to the **Management Configuration** menu.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

```
                    AUTHENTICATION/COMMUNITY MENU
1. Authentication Failure Trap                          On
2. Trap                                                 Public
3. Read                                                 Public
4. Write                                                Public

ESC> Exit

Select item from the menu:
```

Figure 5-8. Authentication/Community Menu

Note *Verify that your **Read** and **Write** communities on the NMS match the ones on IPmux-1/4.*

Manager List

➤ **To configure the Manager in IPmux-1/4:**

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
3. Management Configuration
↓
2. Manager List

1. From the Management Configuration menu, press **2 Manager List** (see *Figure 5-9*).
2. Enter the **Manager IP Address** (the Manager IP Address in *Figure 5-9* is used as an example. Choose the Manager IP Address of your application).
3. Select **Status Change Trap** according to your application requirements (for details refer to *Manager List* in the *IPmux-4 manual*.
4. Select **Alarm Trap** according to your application requirements (for details refer to *Manager List* in the *IPmux-4 manual*.
5. Select **System Trap** according to your application requirements (for details refer to *Manager List* in the *IPmux-4 manual*.
6. Press <**S**> to save the configuration.
7. Press <**Esc**> a few times to return to the **Main** menu.

Note *Remember to press <**Enter**> after modifying each parameter. Press <**S**> to save all changes on the menu.*

```
                              MANAGER LIST
1. Manager IP Address                                  192.114.35.1
2. Status Change Trap                                  On
3. Alarm Trap                                          On
3. System Trap                                         Off

ESC. Exit              S. Save                         N. Next

Select item from the menu.
```

Figure 5-9. Manager List Menu

Note *If you set **Alarm Trap** to **Off** no Alarm Trap will be sent, regardless of the mask defined in the Alarm Trap Mask screen. For further details refer to* Manager List *in the* IPmux-4 or IPmux-1 manual.

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
3. Management Configuration
↓
3. Alarms Trap Mask

Alarms Trap Mask

➤ **To configure the Alarms Trap Mask:**

1. From the **Management Configuration** menu, press **3 Alarms Trap Mask** (see *Figure 5-10*).
2. Select **Trap Status** and choose a value according to your application requirements (for details refer to *Alarms Trap Mask* in the *IPmux-4 manual*.

```
                              ALARMS TRAP MASK
1. Alarm ID            1
2. Trap Status         Active

ESC. Exit              S. Save
ACTIVE ALARM TRAPS:
```

Figure 5-10. Alarms Trap Mask Menu

Default Gateway

If the Manager is not on the same subnet as IPmux-4, configure the Default Gateway.

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
2. Default Gateway

➤ **To configure the Default Gateway:**

1. From the **General Configuration** menu, press **2 Default Gateway** (see *Figure 5-11*).
2. Enter the Gateway IP Address.

```
                              DEFAULT GATEWAY
1. Gateway IP          0.0.0.0


ESC. Exit


Select item from the menu.
```

Figure 5-11. Default Gateway Menu

5.5 Checking the Application

Once you have finished configuring all the IPmux units, there are several levels on which to check the application:

1. Use the IPmux Statistics
2. Check the TDM equipment statistics and functionality.

Using IPmux Statistics – Step 1

➤ **To check the application using IPmux Statistics:**

1. Select the **Performance Monitoring** menu in IPmux-4.
2. Select the **Bundle Connection Status** menu and verify that the connectivity status is OK, and that you don't have any sequence errors, underflows or overflows rising. Verify this for both Bundle 32 and Bundle 33.
3. If the connectivity status is not OK (either local or remote failure):
   - Check that all cables and physical connections on the IP side are OK.
   - Check that the Bundle Connection configuration was properly made.
   - Check that the IP Addresses and Default Gateways are configured correctly.
4. If you have sequence errors and underflows:
   - Check under **LAN Statistics** that your Ethernet connection is full duplex. If it is detected as half duplex, this could indicate that a problem exists in the Auto-negotiation mechanism between IPmux and the switch/router. In this case, set both devices to Auto-negotiation Disable, default type on IPmux to full duplex, and either 10M or 100M, according to the switch/router capability.
   - Check under LAN Statistics that only the correct frames and correct octets are received and transmitted. If other counters are rising, check the physical connection of the IP side (cables, switch/router port, etc.).
5. If you have underflows or overflows at set intervals of time:
   - Check that all IPmux units are configured to the correct clock modes.
   - Check that the TDM device is configured to the correct clock mode.

6. If you have underflows or overflows at non-set intervals of time:
   - Try to gradually increase the jitter buffer size.
   - Check that there are no E1alarms (such as LOS or LOF), through the IPmux E1/T1 Statistics. If problems do exist on the E1/T1 level, check both physical connections (cables and E1 ports) and E1/T1 parameter configuration compatibility between the TDM equipment and the IPmux units (such as CRC and CAS Enable/Disable).
   - Check that the Bundle connection configuration was made correctly.

For further information, see the IPmux *Troubleshooting and Diagnostics* chapter.

Using TDM Equipment Statistics and Functionality – Step 2

After you have verified all the issues in *Step 1*, make the following checks.

1. Check that there are no alarms or BER on the TDM equipment.
2. If you are using a PABX check voice quality. IF echo exists, verify that you haven't configured the jitter buffer size to be too large (remember that the initial configuration should be 3 ms, unless it is required to be larger due to problems seen under the *Bundle Connection Status*).

Appendix A

Boot Sequence for Downloading Software

A.1 General

This chapter provides a description of the IPmux-1/1E boot procedure via an ASCII terminal for downloading software.

The IPmux-1/1E software is stored in flash memory in two sections, in the boot sector and in the file system. The boot sector holds a boot program that calls up the rest of the program from the file system.

The file system can hold two compressed copies of the IPmux-1/1E code. One copy is called the operating file, and the other is called the backup file. The operating file is the default-executable IPmux-1/1E code. The backup file is used whenever the operating file is absent or corrupted.

A.2 Booting IPmux-1/1E

General

IPmux-1/1E boots up automatically. After powering up, no user intervention is required, except when the user wants to access the file system to modify or update the software or the IPmux-1/1E configuration.

Boot Sequence

The following is a description of the boot sequence. If the system is working normally, the entire process is completed within 30 seconds. Refer to *Figure A-1*.

```
BOOT Program V 1.21 7-1-2001 08:35
 Flash : size 3e0000h, FileSys sectors 62
   BOOT Program is running !!!
   Checking File System.........-> exists.
   Backup file EXIST
   Operating file EXIST
   Press Cntl-A within 3 seconds to get File-System Menu !!!
   FileName: ipmux1.bin
   #c1cod code: V 2.00 8-9-2000 11:58
   got start addr : 100000
   Decompression-process........
   Decompression Ended !!!
Jumping to Application, addr = 100008.
```

Figure A-1. Boot Screen

1. The boot program searches for the operating file in the file system.
   - If the file exists, a message appears on the screen and the program continues.
   - If the file does not exist, the boot program searches for the backup file, renames the file to **Operating** file (a message appears on the screen) and continues.
   - If there is no backup file, you must download a file via the out-of-band interface (XMODEM protocol). The received file is saved as the operating file in the file system.
2. Files in the file system are compressed and automatically decompressed into the RAM memory before execution begins. A message appears on the screen.
3. After decompression, the IPmux-1/1E software starts to execute and the user can begin working.

Accessing the File System

The file system menu is an option that allows the user to perform basic file transfer operations. These operations are all optional.

If an operating file exists in the file system, there is a three-second delay.

➤ **To access the file system;**

- Press **<Cntl-A>** within this delay interval

  The File System menu is displayed (see *Figure A-2*). .

Note *If you do not press **<Cntl-A>** within three seconds, booting continues normally.*

```
                          IPmux-1/1E BOOT MENU


The device can store two software files in its File System.
One is called Operating file and the Second is called Backup file.
Operating file              EXIST
Backup file                 EXIST
Configuration file          EXIST


0. Exit
1. File swap: Operating⇔Backup
2. Download NEW Operating file
(existing Operating file will be saved as Backup)
3. Delete Operating file
(existing Backup file will be saved as Operating)
4. Delete Configuration file
9. Delete ALL FileSystem (Software and Configuration files)
Type in one of the above option numbers (or <ESC> to exit) :
```

Figure A-2. File System Menu

From the File System menu, you can:

- Exchange the operating and backup files.
- Download a new operating file; the previous operating file is saved as the backup file.
- Delete the operating file; the backup file becomes the operating file.
- Delete the configuration file.
- Delete all the software and configuration files.

If you choose to exchange or delete a file, you are prompted for confirmation.

Appendix B
Telnet

B.1 General

Telnet, which stands for Telecommunications Network, is a protocol that gives you the ability to connect to a remote machine, by giving commands and instructions interactively to that machine, thus creating an interactive connection. In such a case, the local system becomes transparent to the user, simulating a direct connection to the remote computer. The commands typed by the user are transmitted directly to the remote machine and the response from the remote machine is displayed on the user's monitor screen. It is possible to manage the IPmux-1/1E inband via remote ASCII Terminal using the Telnet IP protocol.

B.2 Using Telnet to Manage the IPmux-1/1E

Starting a Telnet Session

IPmux-1/1E is normally controlled by an ASCII terminal emulation application running on an OS. To c mae .00023(2(inal T)t)-el4((mae)-,es)-5mus(mae)- fi4(1((mae)- op3(l

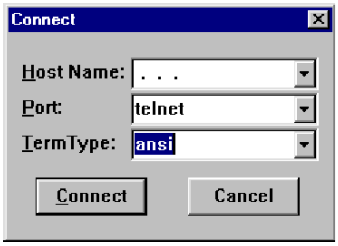


Figure B-1. Telnet Logon Dialog

Telnet Operation

Telnet and ASCII terminal cannot be active at the same time.

If a terminal is active, a Telnet session cannot be established.

➤ **To establish a Telnet session:**

- Exit the terminal by selecting Exit in the Main menu.

  If the auto-disconnect is ON, the terminal will be disconnected automatically after 15–30 minutes if no characters were sent (see the ASCII terminal Configuration Menu – *Appendix E*).

  Terminal management has priority over Telnet, if a Telnet session is active and a user logs on to the terminal, the Telnet session will be disconnected and the terminal will be the active form of management.
  Parameters set to default values via Telnet will not erase the Host and Default Gateway parameters, to prevent a loss of connectivity.

Note *When configured to default values from the terminal, Host and Default Gateway parameters will be optionally erased. The user can configure to default parameters and then decide to keep/erase the Host and Default Gateway.*

System Security

A user name and password is required to log on and initiate a Telnet session.

- The Terminal session exits to the password screen and the Telnet session disconnects after 15 to 30 minutes of inactivity.

Note *The inactivity time-out feature may be deactivated via the ASCII Terminal Configuration window.*

Main Menu ⇒ Configuration ⇒ General Configuration ⇒ ASCII Terminal Configurations, menu line 4: 15 Minute Timeout)

Appendix C

SNMP Management

Appendix C provides specific information for IPmux-1/1E management by SNMP (Simple Network Management Protocol).

The SNMP management functions of IPmux-1/1E are provided by an internal SNMP agent. The SNMP management communication uses UDP (User Datagram Protocol), which is a connectionless-mode transport protocol, part of the IP (Internet Protocol) protocol suite.

This appendix covers the information related to the SNMP environment.

C.1 SNMP Environment

SNMP Principles

The SNMP management protocol is an asynchronous command-response polling protocol. All management traffic is initiated by the SNMP-based network-management station, which addresses the managed entities in its management domain. Only the addressed managed entity answers the polling of the management station (except for trap messages).

The managed entities include a function called an SNMP agent, which is responsible for interpretation and handling of the management station requests to the managed entity, and the generation of properly formatted responses to the management station.

SNMP Operations

The SNMP protocol includes four types of operations:

- **getRequest**: Command for retrieving specific management information from the managed entity. The managed entity responds with a **getResponse** message.
- **getNextRequest**: Command for retrieving sequentially specific management information from the managed entity. The managed entity responds with a **getResponse** message.
- **setRequest**: Command for manipulating specific management information within the managed entity. The managed entity responds with a **getResponse** message.
- **trap**: Management message carrying unsolicited information on extraordinary events, which are events that occurred not in response to a management operation reported by the managed entity.

Management Information Base (MIB)

The MIB includes a collection of managed objects. A managed object is defined as a parameter that can be managed, such as a performance statistics value. The MIB includes the definitions of relevant managed objects. Various MIBs can be defined for various management purposes or types of equipment.

An object definition includes the range of values (also called instances) and the following access rights:

- **Read-only**: Instances of that object can be read, but cannot be set.
- **Read-write**: Instances of that object can be read or set.
- **Write-only**: Instances of that object can be set, but cannot be read.
- **Not accessible**: Instances of that object cannot be read, or set.

MIB Structure

The MIB has an inverted tree-like structure, with each definition of a managed object forming one leaf, located at the end of a branch of that tree.

Each leaf in the MIB is reached by a unique path. Thus, by numbering the branching points starting with the top, each leaf can be uniquely defined by a sequence of numbers.

The formal description of the managed objects and the MIB structure is provided in a special standardized format, called ASN.1 (Abstract Syntax Notation 1). Since the general collection of MIBs can also be organized in a similar structure, under IAB (Internet Activities Board) supervision, any parameter included in a MIB that is recognized by the IAB is uniquely defined.

To provide the flexibility necessary in a global structure, MIBs are classified in various classes (branches). One is the experimental branch and another the group of private (enterprise-specific) branch.

Under the private enterprise-specific branch of MIBs, each enterprise (manufacturer) can be assigned a number, which is its enterprise number. The assigned number designates the top of an enterprise-specific sub-tree of non-standard MIBs. Within this context, RAD has been assigned the enterprise number **164**. Therefore, enterprise MIBs published by RAD can be found under **1.3.6.1.4.1.164**.

MIBs of general interest are published by the IAB in the form of a Request for Comment (RFC) document. In addition, MIBs are also often assigned informal names that reflect their primary purpose. Enterprise-specific MIBs are published and distributed by their originator, who is responsible for their contents.

MIBs Supported by the IPmux-1/1E SNMP Agent

The interpretation of the relevant MIBs is a function of the SNMP agent of each managed entity. The general MIBs supported by the IPmux-1/1E SNMP agent are:

- rfc1213.mib (except the interfaces view which is supported via RFC 2233)
- ianaiftype.mib (defines the ifType)

- rfc2233.mib (IF-MIB)
- rfc1493.mib
- rfc2665.mib
- rfc1907.mib
- rfc2493.mib
- ces.mib
- rfc2127 (ISDN-MIB)
- rfc2495.mib (except Far End objects and RW configuration objects which are different for each configuration) - replaces RFC 1406; which is now obsolete.
- rfc2494.mib
- rfc2239.mib
- IP-MUX RAD private mib

The IPmux-1 object id is
iso (1).org(3).dod(6).internet(1).private(4).enterprises(1).rad(164).radGen(6).systems(1).radSysIPMux(3).IPmux1(82)

The IPmux-1E object id is
iso (1).org(3).dod(6).internet(1).private(4).enterprises(1).rad(164).radGen(6).systems(1).radSysIPMux(3).IPmux1E(84)

Enterprise-specific MIBs supported by RAD equipment, including IPmux-1/1E6, are available in ASN.1 format from the RAD Technical Support Department.

Management Domains under SNMP

In principle, SNMP allows each management station that recognizes the MIBs supported by a device to perform all the management operations available on that device. However, this is not desirable in actual practice, it is necessary to provide a means to delimit management domains.

SNMP Communities

SNMP delimits management domains by defining communities. Each community is identified by a name, which is an alphanumeric string of up to 255 characters defined by the user.

The IPmux-1/1E SNMP agent defines strings of up to 10 characters (case sensitive, numeric and alphabetical).

Any SNMP entity (both managed entities and management stations) is assigned a community name by its user. In parallel, the user defines a list of the communities for each SNMP entity that are authorized to communicate with the entity, and the access rights associated with each community (this is the SNMP community name table of the entity).

In general, SNMP agents support two types of access rights:

Read-Only: The SNMP agent accepts and processes only SNMP **getRequest** and **getNextRequest** commands from management stations which have a Read-Only community name.

Read-Write: The SNMP agent accepts and processes all the SNMP commands received from a management station with a Read-Write community name.

Authentication

In accordance with SNMP protocol, the SNMP community of the originating entity is sent in each message.

When an SNMP message is received by the addressed entity, it first checks the originator's community. Messages with community names not included in the SNMP community names table of the recipient are discarded. SNMP agents of managed entities usually report this event by means of an authentication failure trap.

The SNMP agents of managed entities evaluate messages originated by communities appearing in the agent's SNMP community names table in accordance with the access rights, as previously explained. Thus, a **setRequest** for a MIB object with read-write access rights will nevertheless be rejected if it comes from a management station whose community has read-only rights with respect to that particular agent.

Network Management Stations

The IPmux-1/1E SNMP agent stores the IP address of the Network Management Station (NMS) that is intended to manage it.

Appendix D
TFTP Download Procedures

D.1 Inband TFTP Download Procedure

General

New IPmux-1/1E software version can be downloaded to the IPmux-1/1E using TFTP. There are three possible procedures:

- Users who access IPmux using Telnet can perform software download and configuration upload/download using the configuration screens. For details, see Download/Upload using TFTP (see *Appendix E*).
- Users who have access to the RADview Network Management – for more details refer to *RADview-HPOV Network Management System for IP Applications*.
- Users who access a MIB browser – the TFTP downloading procedure is illustrated in *Figure D-1*.

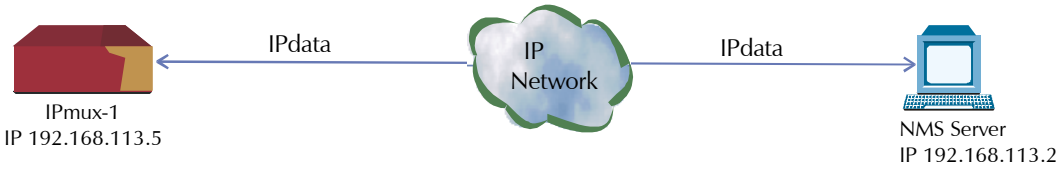


Figure D-1. TFTP Downloading Procedure

The IPmux-1 manager station must be equipped with a TFTP server and the new software.

Warning

The procedures in this chapter should be performed only by a UNIX expert.

➤ **To start download:**

1. Set the appropriate IPmux-1/1E MIB parameter. IPmux-1/1E then sends requests to the TFTP server (where the new software resides) and receives packets of data.
2. If there is no TFTP server available to the main manager, assign a station where there is a TFTP server installed. This server becomes a secondary manager. In this case, the main manager only initiates the download process (by setting the MIB parameter), which is then performed between IPmux-1/1E and the TFTP server.

Preliminary Procedure

➤ **Before performing TFTP download:**

1. Ping IPmux-1/1E from the station running the TFTP server to ensure that IPmux-1/1E has communication with the machine.
2. Log in as **SUPERUSER (su)**.
3. Edit the file named ***inetd.conf*** found at the /**etc** directory, as follows:
   – Search for the line starting with a **#** sign followed by **tftp**, for example, ***# tftp*** and delete the **#** sign.
   – At the end of that line, there is ***-S <directory name>***.
   In ***<directory name>*** specify only the path to the file that is to be downloaded to the IPmux-1; for example, /**export**/**home**/**demo**/**tftp**).
4. Save modified file ***inetd.conf*** and **INIT** the Unix machine; for example, in Solaris type ***init 0*** (not the same for SunOS or IRIX or HP-Unix).
5. After the Station reboots, type ***ovw &*** to open ***HPOV***.
6. Open the MIB Browser under ***MISC*** → ***SNMP MIB BROWSER***.
7. Type **iso.org.dod.internet.private.enterprises.rad.radGen.agnt.filetranster**; The Browse MIB window showing the Agent IP and Server IP addresses is displayed.

The fields in are:

- **fileServerIP**: Specify the IP address of the TFTP server where the software file resides.
- **fileName**: Specify the file name containing the new software version, including any path to the file. This name must be under the root directory where the TFTP server was initiated. The name can be up to 12 characters in length; for example, **anteappl.cmp**.
- **fileTransCmd**: Set this parameter to **sw download** (Entry Number 1) to start software download.
- **tftpRetryTimeOut**: Specify the desired time interval, in seconds, between retries (default = 15).
- **tftpTotalOut**: Specify the retry duration, in seconds (default = 60).
- Set the MIB Instance field to **0** (zero).

Downloading should take between 60 to 120 seconds.

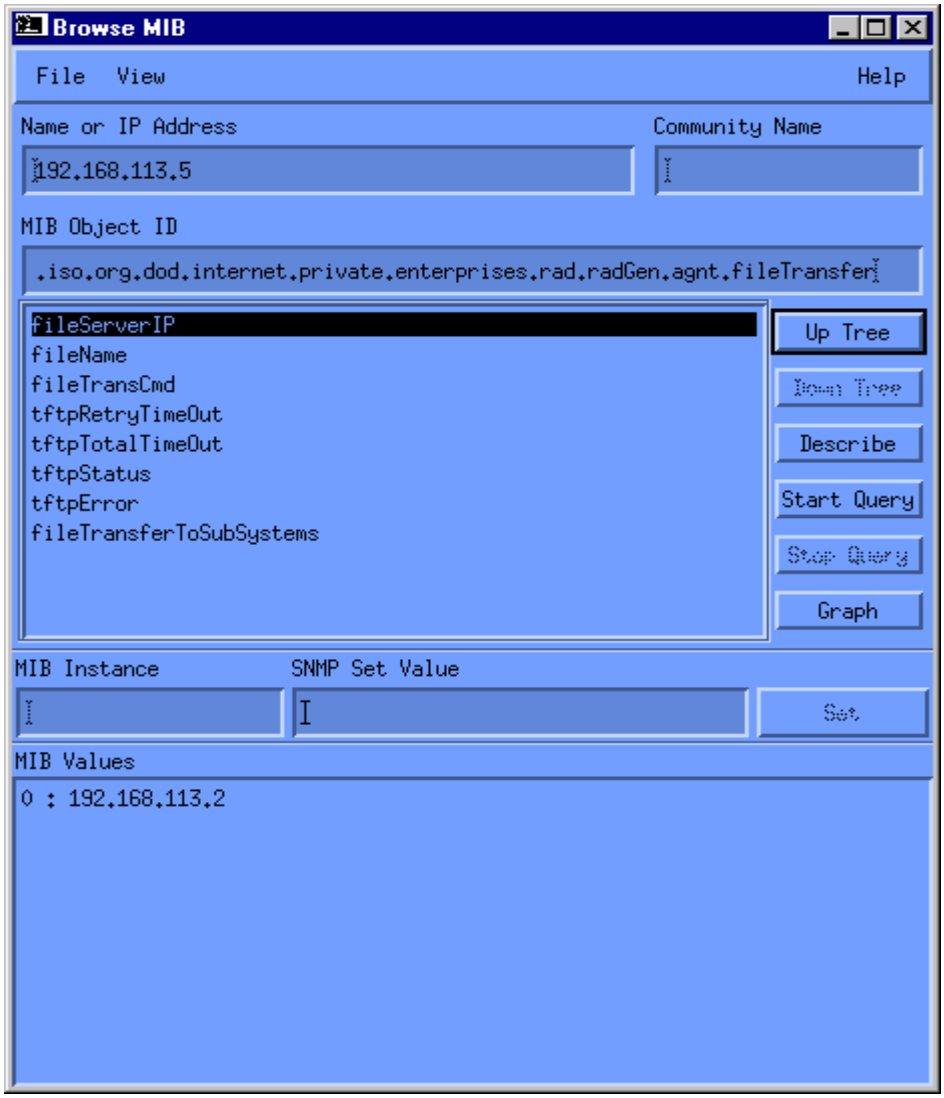


Figure D-2. Agent and Server IP Addresses

Checking the Download

➤ **To check the download:**

1. Log on the MIB Browser again, as follows: iso.org.dod.internet.mgmt.mib-2.system.sysDescr; the MIB Browser window showing the system description is displayed (see *Figure D-3*).
2. Press <**Start Query**>.
3. Scroll right to check that the application version you have just loaded is the correct one.

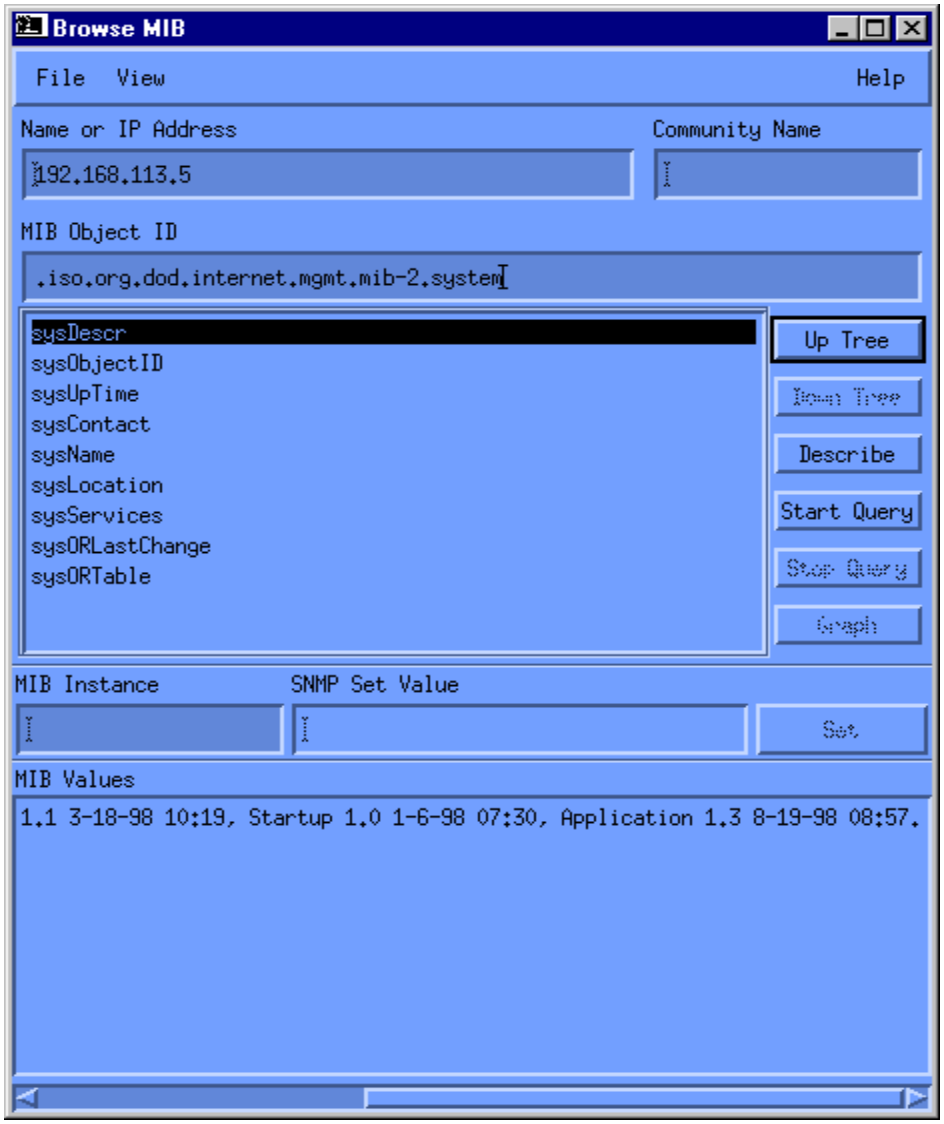


Figure D-3. System Description

Appendix E

Parameters and Screens

This appendix illustrates the IPmux-1/1E screens and explains the parameters for:

- Main Menu in *Section E.1*
- Viewing the IPmux-1/1E System in *Section E.2*
  - General Information
  - Self-Test Results
  - Reset
  - Logfile Events
  - Ping
- General Configuration in *Section E.3*
  - Host IP
  - Default Gateway
  - Authentication/Community
  - Manager List
  - Alarm Traps Mask
  - ASCII Terminal Configuration
  - Time/Date Update
  - Download/Upload Using Xmodem
  - TFTP
  - Set Default Parameters
- IPmux-1 E1/T1 Configuration in *Section E.4*
  - E1 Configuration
  - T1 Configuration
- IPmux-1E ISDN Configuration in *Section E.5*
  - ISDN Channel Configuration
- IPmux-1E Analog Configuration in *Section E.5*
  - FXS Channel Configuration
- Signaling Profile Configuration in *Section E.6*
- Bundle Connection Configuration in *Section E.7*
- LAN Configuration (no User port) in *Section E.8*

- DS0 Bundle Configuration in *Section E.9*
- Performance Monitoring in *Section E.10*
  - E1/T1 Statistics
  - ISDN Statistics in IPmux-1E with ISDN
  - FXS Statistics in IPmux-1E with FXS
  - LAN Statistics
  - Bundle Connection Statistics
- Ethernet Menus – two ports in *Section E.11*
  - General Information
  - LAN Configuration
  - Aging Time
  - LAN Statstics

E.1 Main Menu

The Main Menu options are:

1. **System** View and modify system parameters

2. **Configuration** Define system configuration

3. **Performance Monitoring** Monitor system performance

4. **Exit** Exit the control software

The following sections in this appendix explain the parameters in each of the menu options.

```
                          MAIN MENU
1.System                                  >
2.Configuration                           >
3.Performance Monitoring                  >
4.Exit

Select item from the menu:_

Use keys <1> to <4>
```

Figure E-1. IPmux-1/1E Main Menu

E.2 Viewing the IPmux-1/1E System

General Information

Main Menu
↓
1. System Menu
↓
1. General Information

This screen displays information including software and hardware versions and module descriptions.
A typical General Information window is shown:

- IPmux-1 E1/T1 in *Figure E-2*
- IPmux-1E ISDN-S in *Figure E-3*
- IPmux-1E FXS in *Figure E-4*.

```
              GENERAL INFORMATION
Software Version              Hardware Version   Inventory No.
Boot: 1.21 7-1-2001 08:35     HW:0.0             236946
Application: 2.00 9-4-01 12:02
Backup:      2.00 9-4-01 12:02
Interface Description
 E1 over UTP
 ETHERNET over UTP

Press ESC to exit
```

Figure E-2. General Information Window

```
              GENERAL INFORMATION
Software Version              Hardware Version   Inventory No.
Boot: 1.21 7-1-2001 08:35     HW:0.0             314153
Application: 2.00 9-4-01 12:02
Backup:      2.00 9-4-01 12:02
Interface Description
 ISDN-S over UTP
 ETHERNET over UTP

Press ESC to exit
```

Figure E-3. General Information Window – ISDN

```
                    GENERAL INFORMATION
Software Version              Hardware Version   Inventory No.
Boot: 1.21 7-1-2001 08:35     HW:0.0             314154
Application: 2.00 9-4-01 12:02
Backup:      2.00 9-4-01 12:02
Interface Description
 FXS over RJ11
 ETHERNET over UTP

Press ESC to exit
```

Figure E-4. General Information Window – FXS

Self-Test Results

Main Menu
↓
1. System Menu
↓
2. Self-Test Results

```
                    SELF-TEST RESULTS
FRAMER TEST.........................PASS
FAST ETHERNET TRANSCEIVER TEST.......PASS



        Press ESC to exit
```

Figure E-5. Last Self-Test Results Window

➤ **For details:**

- Type **M**. If a problem is encountered refer to *Chapter 4*.

Table E-1. Last Self-Test Results Parameters

Parameter	Possible Values	Remarks
Framer Test	**Pass, Fail**	
Fast Ethernet Transceiver Test	**Pass, Fail**	

Reset

Main Menu
↓
1. System Menu
↓
3. Reset

➤ **To reset the IPmux-1/1E configuration:**

1. Type **3** (Reset) in the **System Menu**.
   A confirmation message appears.
2. Press **Y** to confirm System Reset for IPmux-1/1E.

```
Are you sure you want a total reset??? (Y/N)
```

Figure E-6. Reset Confirmation Message

Logfile Events

Main Menu
↓
1. System Menu
↓
4. Event Log
↓
1. Read Logfile

```
                          LOGFILE EVENTS


 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START
 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START
 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START
 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START


ESC. Exit      N. Next
```

Figure E-7. Logfile Events – Sample Menu

For the full Events List see *Chapter 4*.

Ping

Main Menu
↓
1.System Menu
↓
5. Ping

This option enables the user to ping other network devices for diagnostic purposes.

1. Enter the destination IP address and press **<Enter>**.
2. To determine the number of ping repetitions, use the **<Space bar>** and then press <**Enter**> to start pinging.

```
                                PING
Enter Destination IP And Press Enter.
Destination IP: 1.1.1.2
Use Space Bar to Choose Ping Repetitions
Ping Repetitions: Endless Repeats
Pinging.
         ------------------------------------------
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out
          Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         |Ping Result:Host 1.1.1.2 Request Timed Out|
         ------------------------------------------
Scrolling Up


ESC. Stop Pings
```

Figure E-8. Ping Dialog Box

E.3 General Configuration

Host IP

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
1. Host IP

➤ **To configure the Host IP address and IP Mask:**

1. Type the IP Address.
2. Type the IP Mask.

```
                              HOST IP
1. IP Address 192.168.217.12
2. IP Mask    255.255.255.0


ESC. Exit
Select item from the menu:_
```

Figure E-9. Host IP Menu

➤ **To change a configured Host IP:**

- Set the device to the default settings.

Note *Frames are not sent until IP and Mask addresses are defined.*

Default Gateway

Main Menu ↓ 2. Configuration ↓ 1. General Configuration ↓ **2. Default Gateway**

Default gateway defines the management ***next hop***. When next hop is not defined for the bundle connection the default gateway address will be used.

➤ **To configure the default gateway:**

1. Type **2** (Default Gateway) in the **General Configuration** menu.
2. Enter the **Default Gateway IP address**.

Note *The Default Gateway must be in the same subnet as the Host.*

Authentication/Community

Main Menu ↓ 2. Configuration ↓ 1. General Configuration ↓ 3. Management Configuration ↓ **1. Authentication/ Community**

```
                    AUTHENTICATION/COMMUNITY
1. Authentication Failure Trap          Off
2. Trap                                 public
3. Read                                 public
4. Write                                public

Select item from the menu.
Use <Esc> key or keys <1> to <4>
```

Figure E-10. Authentication/Community Menu

Table E-2. Authentication/Community Parameters

Parameter	Possible Values	Remarks
Authentication Failure Trap	**On** **Off**	On – an authentication-failure trap is generated when a system manager attempts to set a parameter within IPmux-1/1E with an incorrect community value
Trap	Up to 10 alphanumeric characters	The entry is case-sensitive
Read	Up to 10 alphanumeric characters	The entry is case-sensitive
Write	Up to 10 alphanumeric characters	The entry is case-sensitive

Manager List

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
3. Management Configuration
↓
2. Manager List

The Manager List window parameters are used when IPmux-1 inband management capability is used. The parameters define the parameters for up to eight managers. These parameters are:

- Manager IP address
- Host index

In addition, the Manager List window parameters configure the traps to be received by a manager. The default value for all traps is **Off**.

➤ **To access additional manager-list parameters:**

- Press **<N>** to go to the next Manager List window.

```
                          MANAGER LIST
1. Manager IP Address                      192.333.234.172
2. Alarm Trap                              On
3. Status Change Trap                      On


ESC. Exit                S. Save           N. Next
Select item from the menu.
Use <Esc> key or keys <1> to <3>
```

Figure E-11. Manager List Menu

Table E-3. Manager List Parameters

Parameter	Possible Values	Function
Manage IP Address	**0.0.0.0.** to **255.255.255.255**	Set the manager IP address
Alarm Trap	**On**	The alarm trap informs the manager of the occurrence of any alarm enabled in the Alarms Trap Mask screen. It informs the manager of both entry and exit from an alarm state.
	Off	No Alarm Trap will be sent regardless of the Mask defined in the Alarm Trap Mask screen
Status Change Trap	**On**	The status-change trap informs the manager that a LED indicator on the front panel has changed its indication.
	Off	No Status Change Trap will be sent

Alarm Traps Mask

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
3. Management Configuration
↓
3. Alarm Traps Mask

Each of the IPmux-1/1E alarms can activate a trap toward the NMS. It is possible to enable/disable the trap operation for each one of the alarms, using the Alarm Trap Mask screen.

```
                        ALARM TRAPS MASK
1. Alarm ID <refer to Manual>              1
2. Trap Status                             Active

Alarm Active Traps:
Select item from the menu.
Use <Esc> key or keys <1> to <2>
```

Figure E-12. Alarm Traps Mask Menu

Table E-4. Alarm Traps Mask Parameters

Parameter	Possible Values	Remarks
Alarm ID	**1, 2, 6, 8, 21, 26, 27**	IPmux-1/1E alarm
Trap Status	**Active**	Generates an alarm
	Masked	Does not send an alarm
		Default for all traps: **Masked**

Table E-5. IPmux-1/1E Alarms

Alarm ID	Alarm Description	Trap Sent to NMS
1	Loss of Signal (LOS Physical Layer)	Alarm LOS 1.3.6.1.4.1.164.6.1.3.0.7
2	Loss of Frame (LOF Physical Layer)	Alarm LOF 1.3.6.1.4.1.164.6.1.3.0.8
6	Alarm Indication Signal Received (AIS Line Physical Layer)	Alarm AIS 1.3.6.1.4.1.164.6.1.3.0.10
8	Remote Defect Indication Received (RDI Line Physical Layer)	Alarm RDI 1.3.6.1.4.1.164.6.1.3.0.11
21	Far End Block Error (FEBE Line Layer)	Alarm FEBE 1.3.6.1.4.1.164.6.1.3.0.12
26	Local Connectivity Fail	Local Conn Status Trap 1.3.6.1.4.1.164.6.1.3.0.13
27	Remote Connectivity Fail	Remote Conn Status Trap 1.3.6.1.4.1.164.6.1.3.0.14

Note *The other alarms are not used.*

ASCII Terminal Configuration

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
4. ASCII Terminal Config

```
                    ASCII TERMINAL CONFIGURATION

1. Display Mode          Color
2. Baud Rate (bps)       19200
3. Change Password
4. 15 Min. Timeout       On


ESC. Exit
   NOTICE:  Change the Baud Rate of the ASCII terminal after
          changing and saving of new Baud Rate data !
Select item from the menu:_
Use <Esc> key or keys <1> to <4>
```

Figure E-13. ASCII Terminal Configuration Menu

Table E-6. ASCII Terminal Configuration Parameters

Name	Possible Values	Remarks
Display Mode	**Color** **MonoChrome 3 color** **MonoChrome 2 color**	
Baud Rate	**9600, 19200, 38400, 57600, 115200** – in units of bps	Default: **19200** bps
Change Password		Choose this option to enter a menu that allows the user to change the current password
15 Min. Timeout	**On, Off**	On – terminal/Telnet exits to the password screen if no characters are sent by the terminal for 15 minutes

Time/Date Update

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
5. Time/Date

```
                    TIME/DATE UPDATE
1. Set Time (hh:mm:ss)                  16:09:12
2. Set Date (yyyy-mm-dd)                2001-04-17
ESC. Exit

Select item from the menu:_
Use <Esc> key or keys <1> to <2>
```

Figure E-14. Time/Date Update Menu

Table E-7. Time/Date Update Parameters

Parameter	Possible Values	Remarks
Set Time	**00:00:00 – 23:59:59**	Time setting in the device
Set Date	**1970/01/01 – 2099/01/01**	Date setting in the device

Download/Upload Using Xmodem

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
6. Software Download
↓
1. Download/ Upload by X-Modem

Only configuration files can be uploaded. If you enter a software file, the **U. Upload** option is not displayed.

➤ **To Download/Upload using Xmodem:**

1. On the Software Download menu, select **1** (Download/Upload Using Xmodem).

   A confirmation message appears.

2. Select **Y**.

   Upon confirmation, the download or upload procedure begins.

```
              DOWNLOAD/UPLOAD USING XMODEM
1. File                 Application code
ESC. Exit               D. Download

Select item from the menu.
Use <Esc> key or keys <1> to <1>
```

Figure E-15. Download/Upload Using X-Modem Window

Table E-8. Download/Upload Using X-Modem Parameters

Parameter	Possible Values	Remarks
File	**Application code, Configuration code, Boot code**	
Download/Upload	**D**	Download a software or configuration file
	U	Upload a configuration file

TFTP

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
6. Software Download
↓
2. Download/ Upload by TFTP

```
                DOWNLOAD/UPLOAD USING TFTP
1. File name
2. Command                              No Operation
3. Server IP                            0.0.0.0
4. Retry timeout                        15
5. Total timeout                        60
6. View transfer status
ESC. Exit

Select item from the menu.
Use <Esc> key or keys <1> to <6>.
```

Figure E-16. Download/Upload Using TFTP Window

Table E-9. Download/Upload Using TFTP Parameters

Parameter	Possible Values	Remarks
File name		
Command	**No Operation, Software Download, Configuration Download, Configuration Upload**	
Server IP		IP address of the server from which the file is loaded
Retry Timeout		Selected retry timeout period (in seconds)
Total Timeout		Selected total timeout period (in seconds), which is the maximum time allowed for attempted transmission
View Transfer Status		View the transfer status in real-time. It is updated every second. The screen is read-only.

➤ **To save the parameters and start the transmission process:**

- Enter **S**.

  If all parameters are correct, you will be asked for confirmation. After confirmation, the TFTP session begins. You can view the Transfer Status (see *Figure E-17*).

The View Transfer Status values are listed in listed in *Table E-10*.

Note *Boot code download is not possible using TFTP.*

Note *Reboot the system after you have completed TFTP download via X-Modem screens.*

```
                    VIEW TRANSFER STATUS
Status   Transferring Data
Error    No Error
Use <Esc> key to Exit
```

Figure E-17. View Transfer Status Window

Table E-10. View Transfer Status Parameters

Parameter	Values	Remarks
Status Indication	**No Operation, Connecting, Transferring Data, Ended on Time Out, Ended OK, Error**	
Error Message	**Unavailable (no host IP), No Error, File Not Found, Illegal TFTP Operation, Unknown Transfer ID, Illegal PDU Size, Illegal File Mode, No Empty Connection, No Empty UDP Port, Server Overflow**	

Set Default Parameters

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
7. Set Default Parameters

Setting Default Parameters reconfigures the device according to default parameters. Before overwriting the system, the warning in *Figure E-18* appears asking you to confirm your selection.

```
Configuration will be overwritten and system will RESET.
                    Continue ? (Y/N)
```

Figure E-18. Reset Default Warning

➤ **To overwrite the system and reconfigure it according to default settings:**

- Type **Y**.

  IPmux-1 is reconfigured according to default settings. Following this, IPmux-1 performs an automatic Reset.

  OR

- Type **N** to exit and return to the General Configuration menu.

Note

1. *Setting default parameters from an ASCII terminal erases all the configurations and optionally asks if you want to erase Host IP and Default Gateway Configuration.*
2. *Setting default parameters from Telnet or NMS does not erase the Host IP or Default Gateway Configuration.*

E.4 IPmux-1 E1/T1 Configuration

E1 Configuration

Main Menu
↓
2. Configuration
↓
2. E1/T1 Configuration

```
                    E1 CONFIGURATION
1. Channel Status                       Enable
2. Transmit Clock Source                Adaptive
3. Loopback State                       Disable
4. Rx. Sensitivity                      -10dB
5. Line Type                            CRC4 enable
6. Idle Code                            7E
7. Signaling Mode                       CAS enable
8. Cond. Data pattern                   FF
9. Cond. CAS (ABCD)pattern              01
ESC. Exit

Select item from the menu.
Use <Esc> key or keys <1> to <9>
```

Figure E-19. E1 Physical Layer Configuration Menu

Note

When "unframed" mode is selected, the Idle Code, Signaling Mode, Cond Data Pattern and Cond CAS Pattern fields are not present.
When CAS Disabled is selected, the Cond CAS Pattern field is not present.

Table E-11. E1 Physical Layer Configuration Parameters

Parameter	Possible Values	Remarks
Channel Status	**Enable**	Detection of LOS alarm
	Disable	No detection of LOS alarm
		Default value: **Enable**
Transmit Clock Source	**Adaptive**	Adaptive clock regeneration
	Loopback	The E1 recovered receive clock is used as the transmit clock.
	Internal	A local clock source is used.
		Default value: **Adaptive**
Loopback State	**Internal**	Data received from the IP network side will be looped back to the network transmit line. An unframed all '1' code (AIS) will be transmitted in the E1 Tx path toward the PBX. Incoming data from the PBX will be ignored.
	External	Data received from the PBX at the receive E1 line will be looped back to the E1 Tx path (toward the same PBX), and will continue its way to the IP network. Data coming from the IP network will be ignored.
	Disable	No loopback; regular operation
		Default value: **Disable**
Rx Sensitivity	**–10 dB,–32 dB**	Maximum attenuation of the receive signal that can be compensated for by the interface receive path
		Default value: E1: **–10 dB**
Line Type		Framing mode and operation mode for each configuration
	Unframed	Framer will be configured to pass through mode and the operation mode will be set to Transparent (see *Chapter 1*)
	CRC4 Enable	Framer will be configured to CRC4 MF mode. Operation mode will be set by Signaling Mode field #6 to either Fractional or Fractional with CAS (see *Chapter 1*).
	CRC4 Disable	CRC4 MF mode is disabled. Operation mode will be set by Signaling Mode field #6 to either Fractional or Fractional with CAS (see *Chapter 1*).
		***Note**: Changing the Line Type setting disables the Line.*
		Default value: **CRC4 enabled**
Idle Code	**00** to **FF**	Determines the idle code inserted into unused timeslots by IPmux-1 at the transmit path towards E1 equipment.
		***Note**: This field will not appear if "unframed" is selected in the Line Type field.*
		Default value: **7E**

Table E-11. E1 Physical Layer Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Signaling mode	**CAS enable**	The E1 framer is set to CAS MF mode and the operation mode to fractional with CAS mode.
	CAS disable	CAS MF will not be set in the E1 framer and the operation mode will be configured to fractional mode. ***Note**: This field will not appear if "unframed" is selected in the Line Type field.* Default value: **CAS Enable**
Byte Code	**00** to **FF**	Conditioning pattern can be applied to timeslots toward the IP path when loss of signal, loss of frame or AIS is detected at the E1 line. Conditioning pattern can also be applied to timeslots toward the E1 line when packet receive buffer overrun or under-run occurs. In Unframed mode, conditioning state will result in AIS transmission. This will be applied when a LOS is detected at E1 line, or when packet receive buffer overrun or under run occurs. ***Note**: This field will not appear if "unframed" is selected in the Channel Type field.* Default Value: **FF**
4 bit code	**1** to **F**	The ABCD conditioning pattern can be applied toward the IP path when loss of signal, loss of frame, or AIS is detected at the E1 line. Conditioning pattern can also be applied toward the E1 line when packet receive buffer overrun or underrun occur. ***Note**: This field will not appear if "Unframed" is selected in the Channel Type field.* Default Value: **1**

T1 Configuration

Main Menu
↓
2. Configuration
↓
2. E1/T1 Configuration

```
                        T1 CONFIGURATION
1. Channel Status                          Enable
2. Transmit Clock Source                   Adaptive
3. Loopback State                          Disable
4. Line Type                               T1-ESF
5. Line Code                               B8ZS
6. Line Mode                               DSU
7. Line Length/Tx Gain                     0-133
8. Restore Time                            1 second
9. Idle Code                               7E
A. Signaling Mode                          CAS enable
B. Cond. Data pattern                      7F
C. Cond. CAS (AB/ABCD) pattern             01
D. Cond. CAS first 2.5 sec pattern(FF=NULL) FF

ESC. Exit

Select item from the menu.
```

Figure E-20. T1 Physical Layer Configuration Menu

Note

When "unframed" mode is selected, the Restore Time, Idle Code, Signaling Mode, Cond Data Pattern, Cond CAS (AB/ABCD) Pattern and Cond. CAS first 2.5 sec pattern (FF=NULL) fields are not present.
When CAS Disabled is selected, the Cond CAS Pattern and Cond. CAS first 2.5 sec pattern (FF=NULL) fields are not present.

Table E-12. T1 Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Restore Time	**1 second,** **10 seconds**	Selects the T1 red alarm recovery time Default value: **1 second**
Idle Code	**00** to **FF**	Inserted into unused timeslots by IPmux-1 at the transmit path towards T1 equipment ***Note**: This field will not appear if "unframed" is selected in the Line Type field.* Default value: **7E**
Signaling Mode	**CAS enable**	T1 framer is set to CAS mode and the operation mode to Fractional with CAS mode
	CAS disable	CAS mode will not be set in the T1 framer and the operation mode will be configured to Fractional mode ***Note**: This field will not appear if "Unframed" is selected in the Line Type field.* Default value: **CAS Enable**
Cond. data pattern	**00** to **FF**	Byte Code applied to timeslots when fault conditions occur Conditioning pattern can be applied to timeslots toward the IP path when loss of signal, loss of frame or AIS detected at the T1 line. Conditioning pattern can also be applied to timeslots toward the T1 line when packet receive buffer overrun or under-run occurs. In Unframed mode, conditioning state results in AIS transmission. This is applied when a LOS is detected at T1 line, or when packet receive buffer overrun or under run occurs. ***Note**: This field will not appear if "Unframed" is selected in the Channel Type field.* Default value: **7F**
Cond CAS (ABCD) pattern	**1** to **F**	2 or 4 Bit Code applied to AB(D4) or ABCD (ESF) bits when fault conditions occur The ABCD conditioning pattern can be applied toward the IP path when loss of signal, loss of frame or AIS detected at the T1 line. Conditioning pattern can also be applied toward the T1 line when packet receive buffer overrun or under run occur. ***Note**: This field will not appear if "Unframed" is selected in the Channel Type field.* Default value: **1**

Table E-12. T1 Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Cond. CAS first 2.5 sec pattern	**0** to **F** (ESF) **0** to **3** (D4) **FF**	2 or 4 Bit Code applied (during the first 2.5 seconds) to AB(D4) or ABCD (ESF) bits (relevant in CAS mode only) when fault conditions occur. After the first 2.5 seconds the code specified in 'Cond. CAS (ABCD) pattern' is applied. ABCD conditioning pattern can be applied toward the IP path when loss of signal, loss of frame or AIS detected at the T1 line. Conditioning pattern can also be applied toward the T1 line when packet receive buffer overrun or underrun occurs. When configuring FF to this function, this parameter is ignored and the CAS pattern applied in the first 2.5 seconds is the same as defined in ' Cond. CAS (ABCD) pattern'. ***Note**: This field does not appear if "unframed" is selected in the Line Type field or if CAS Disable is selected.* Default value: **FF**

E.5 IPmux-1E ISDN Configuration

Main Menu
↓
2. Configuration
↓
2. ISDN Configuration

```
                    ISDN CONFIGURATION

1. Interfaces Mode                      Terminal
2. Transmit Clock Source                Adaptive
3. Channel Configuration                >
ESC. Exit


Select item from the menu.
```

Figure E-21. ISDN Configuration Menu

Table E-13. ISDN Configuration

Parameter	Possible Values	Remarks
Interfaces Mode	**Terminal**	ISDN S ports are in TE mode
	Network	ISDN S ports are in NT mode
Transmit Clock Source **????**	**Adaptive**	Adaptive clock regeneration
	Loopback	Only when IPmux-1E BRI ports are configured as TE mode – clock is taken from the opposite NT device connected to Channel 1
	Internal	Local clock source is used
Channel Configuration		Next screen

ISDN Channel Configuration

Main Menu
↓
2. Configuration
↓
2. ISDN Configuration
↓
3. ISDN Channel Configuration

```
                ISDN CHANNEL CONFIGURATION
1. Channel Number                          1
2. Channel Status                          Enable
3. Loopback Status                         Disable
4. Phantom Feeding                         Disable
ESC. Exit


Select item from the menu.
```

Figure E-22. ISDN Channel Configuration Menu

Table E-14. ISDN Channel Parameters

Parameter	Possible Values	Remarks
Channel Number	**1, 2, 3, 4**	Select chanel to be configured
Channel Status	**Enable**	Channel is enabled
	Disable	Channel is disabled
Loopback State	**Disable**	No loopback; regular operation
	Internal	An internal loop on IPmux-1E tests the ISDN S line
	External	An external loop on IPmux-1E tests the ISDN S line
Phantom Feeding	**Enable, Disable**	Read-only according to jumper setting on the board

E.6 Analog Configuration

Main Menu
↓
2. Configuration
↓
2. FXS Configuration

```
                    ANALOG CONFIGURATION
1. Clock Source                          Adaptive
2. Far End Type                          E1
3. Channel Configuration                 >
4. Signaling Profile Configuration       >
ESC. Exit
            +---------------------------------------+
            |NOTICE: The connection must be disabled |
            |        before any changes!             |
            +---------------------------------------+

Select item from the menu.
```

Figure E-23. Analog Configuration Menu

Table E-15. Analog Configuration

Parameter	Possible Values	Remarks
Clock Source	**Internal**	Local clock source is used
	Adaptive	Adaptive clock regeneration
Far End Type	**E1**	Sets A-Law/μ-Law and TDMoIP encapsulation mode
	T1-ESF, T1-D4	
Channel Configuration		Next screen
Signaling Profile Configuration		Next screen

Channel Configuration

Main Menu
↓
2. Configuration
↓
2. FXS Configuration
↓
3. Channel Configuration

```
                    CHANNEL CONFIGURATION
1. Channel Number                          1
2. Channel Status                          Enable
3. Rx Gain                                 -4dBm
4. Tx Gain                                 0dBm
5. Testing                                 Disable
ESC. Exit



Select item from the menu.
```

Figure E-24. Channel Configuration Menu

Table E-16. Analog Configuration

Parameter	Possible Values	Remarks
Channel Number	**1,2,3,4**	Selects channel to be configured
Channel Status	**Enable**	Channel is enabled
	Disable	Channel is disabled
Rx Gain	**–10, –8, –6, –4, –2, 0, 1, 2, 3, 4, 5** (dBm)	Sets the gain towards the phone
Tx Gain	**–10, –8, –6, –4, –2, 0, 1, 2, 3, 4, 5** (dBm)	Sets the analog gain as transmitted from the phone to configure the analog receiver dynamic range
Testing	**Tone Injection**	1 kHz tone is injected towards the local phone
	Remote Loopback	A remote loopback analog signal is set for IPmux-1E FXS
	Disable	

Signaling Profile Configuration

Main Menu
↓
2. Configuration
↓
2. Analog Configuration
↓
4. Signaling Profile Configuration

```
                SIGNALING PROFILE CONFIGURATION
1. Rx A                                     A
2. Rx B                                     N/C
3. Rx C                                     N/C
4. Rx D                                     N/C
5. Tx A                                     A
6. Tx A                                     1
7. Tx A                                     0
8. Tx A                                     1


ESC. Exit


             +------------------------+
             |  Rx: From Network      |
             |  Tx: To Network        |
             +------------------------+


Select item from the menu.
```

Figure E-25. Signaling Profile Configuration Parameters

Table E-17. Signaling Profile Configuration

Parameter	Possible Values	Remarks
Rx A	**A, A Inverse, N/C**	Specifies which ABCD Signaling Bit (only one), and its polarity, carries the on hook/off hook information from the far-end device
Rx B	**B, B Inverse, N/C**	Specifies which ABCD Signaling Bit (only one), and its polarity, carries the on hook/off hook information from the far-end device
Rx C	**C, C Inverse, N/C**	Specifies which ABCD Signaling Bit (only one), and its polarity, carries the on hook/off hook information from the far-end device
Rx D	**D, D Inverse, N/C**	Specifies which ABCD Signaling Bit (only one), and its polarity, carries the on hook/off hook information from the far-end device
Tx A	**A, A Inverse, 0, 1**	Specifies which ABCD Signaling Bit carries the on hook/off hook information to the far-end device. One or more can be configured to carry the off-hook/on-hook information (or inverse information), while the other bits should be set to '1' or '0'.

Table E-17. Signaling Profile Configuration (Cont.)

Parameter	Possible Values	Remarks
Tx B	**B, B Inverse, 0, 1**	Specifies which ABCD Signaling Bit carries the on hook/off hook information to the far-end device. One or more can be configured to carry the off-hook/on-hook information, while the other bits should be set to '1' or '0'.
Tx C	**C, C Inverse, 0, 1**	Specifies which ABCD Signaling Bit carries the on hook/off hook information to the far-end device. One or more can be configured to carry the off-hook/on-hook information, while the other bits should be set to '1' or '0'.
Tx D	**D, D Inverse, 0, 1**	Specifies which ABCD Signaling Bit carries the on hook/off hook information to the far-end device. One or more can be configured to carry the off-hook/on-hook information, while the other bits should be set to '1' or '0'.

Note *For example, if Rx = A, then all other Rx must be NC. If Rx = A Inverse, then all other Rx must be NC. Tx can be A, B , 0, 1.*

E.7 Bundle Connection Configuration

Main Menu
↓
2. Configuration
↓
3. Bundle Connection Configuration

```
                BUNDLE CONNECTION CONFIGURATION


1. Bundle ID                              1
2. IP TOS                                 1
3. TDM Bytes in Frame                     48
4. Connection Status                      Disable
5. Destination IP Address                 0.0.0.0
6. Next Hop                               0.0.0.0
7. Destination Bundle                     1
8. Jitter Buffer (x10 µsec) rounded up 1000 µsec steps! 300
9. VLAN Tagging                           YES
A. VLAN Id                                EE
B. VLAN Priority                          00
ESC. Exit


Select item from the menu.
```

VLAN ID and VLAN Priority are configurable only if VLAN Tagging is set to Yes.

Figure E-26. Bundle Connection Configuration

Parameters must be configured for each connection. To configure all parameters, first select the bundle ID and then proceed with the parameter configuration.

Note *First define the bundle.*

Table E-18. Bundle Connection Parameters

Parameter	Possible Values	Remarks
Bundle ID	**1**	IPmux-1 has a single bundle, with the number set at 1
IP ToS	**0** to **255**	Type of Service – sets the IP ToS field in the IP frames transmitted by the device. ToS configuration configures the **WHOLE** byte, since different vendors may use different bits to tag packets for traffic prioritization. ToS assignment applies to all TDM packets leaving IPmux-1. Default configuration: **0**
TDM Bytes in Frame	**48, 96, 144, 192, 240, 288, 336, 384**	Allows you to set the UDP payload length – this parameter enables reduction of Ethernet throughput (detailed explanation in *Chapter 1*). Default payload: single payload (**48**)
Connection Status	**Enable** **Disable**	Connection enabled Frames will not be sent from this connection
Destination IP Address		IP address of the destination device
Next Hop		Use the ***next hop*** parameter when the Destination IP address is not in the device subnet. In such cases the Ethernet frame is sent to the *next hop* IP. If it is not configured, the default gateway is used. Default value: **0.0.0.0** (not configured) ***Note****: The next hop IP must be in the device subnet.*
Destination Bundle	E1: **1** to **496** T1: **1** to **384**	Bundle number in the destination device
Jitter Buffer	**3** to **300 milliseconds (ms**)	Desired depth of the jitter buffer (PDVT buffer). Default value: **300** (10 x µs), i.e. 3 msec
VLAN Tagging	**Yes** **No**	You must set options 9 and A in the Bundle Connection Configuration menu ***Note****: For an explanation of VLAN tagging see Chapter 1.*
VLAN ID	**0** to **4095**	Default value: **0**.
VLAN Priority	**0** to **7**	

E.8 LAN Configuration (no User port)

Note *For LAN configuration for two LANs, see* Ethernet Configuration/Statistics *Menus*.

Main Menu
↓
2. Configuration
↓
4. LAN Configuration

```
                    LAN CONFIGURATION


1. Auto Negotiation              Enable
2. Max Capability advertised     100baseT Full Duplex
3. Default type                  100baseT Full Duplex
ESC. Exit


Select item from the menu.
```

Figure E-27. LAN Configuration Menu

Table E-19. LAN Configuration Parameters

Parameter	Possible Values	Remarks
Auto Negotiation	**Enable, Disable**	Auto Negotiation mode is according to RFC 2239 Default: **Enable**
Maximum Capabilities Advertised		Maximum Capabilities of the port for the Auto Negotiation process (can be lower then the actual capabilities) Default: **100baseT Full Duplex**
Default Type	**10BaseT Half Duplex, 10BaseT Full Duplex, 100BaseT Half Duplex, 100BaseT Full Duplex**	Default: **100baseT Full Duplex** ***Note:*** *This parameter is valid only when the Auto Negotiation mode is disabled (RFC 2239).*

Note *If Auto Negotiation is set to Enable and you experience some incompatibility in the Auto Negotiation process, set Auto Negotiation to Disable and set Default type to the desired mode.*
When the physical port is fiber, the operation mode is:
Auto Negotiation Off//full duplex/100 Mbps. This is the only possible setting.

E.9 DS0 Bundle Configuration

Main Menu
↓
2. Configuration
↓
5. DS0 Bundle Configuration

This configuration selects the timeslots to be transferred end-to-end for E1/T1 when the operation mode is Fractional or Fractional with CAS. One bundle of timeslots can be configured in the IPmux-1 TDMoIP link.

```
                    DS0 BUNDLE CONFIGURATION
1. Bundle ID                                1
2. Timeslot number                          1-1
3. Timeslot Current Status                  SET
ESC. Exit

ACTIVE TIMESLOTS IN THIS BUNDLE: 1
FREE TIMESLOTS: 2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,
                  18,19,20,21,22,23,24,25,26,27,28,29,30,31

Select item from the menu.
Use <Esc> key or keys <1> to <3>
```

Figure E-28. DS0 Bundle Configuration Menu

Table E-20. DS0 Bundle Configuration Parameters

Parameter	Possible Values	Remarks
Bundle ID	**1**	This is the only valid option
Timeslot Number	E1: Timeslot 0 is **always** invalid and timeslot 16 is **not** valid for Fractional with CAS data format. T1: Valid timeslots are 1 to 24	
Timeslot Current Status	Free	Frees the timeslot from the bundle
	Set	Adds the timeslot to the bundle
Active timeslots in this Bundle		Assigned timeslots – read-only
Free Timeslots		Unassigned timeslots – read-only

➤ **To save the change:**

- Type **<S>**.

IPmux-1 will associate the new timeslot with the bundle.

E.10 Performance Monitoring

E1/T1 Statistics

Main Menu
↓
3. Performance Monitoring
↓
1. E1/T1 Statistics

E1 models only

```
                          E1 STATISTICS
E1 over UTP
LOS:                0
LOF (Red):          0
LCV:                0
RAI (Yellow):       0
AIS:                0
FEBE:               0
BES:                0
DM:                 0
ES:                 0
SES:                0
UAS:                0
LOMF:               0
Time Since:         sec   7------Valid Intervals        12----
1. Interval                              0

ESC. Exit   N. Next Inv:
```

Figure E-29. E1/T1 Statistics Menu

The following statistics are valid (and visible) for **ESF and E1-CRC4 modes only**: BES, DM.

The following parameters are saved in the **event log**: LOS, LOF, Rcv.Yellow alarm, Rcv. AIS and FEBE.

Compliance to Standards

E1: G.703, G.704, G.804, G.706, G.732, G.823

T1: ANSI T1.403, AT&T TR62411, G.703, G.704, G.804

The alarms and statistics are described in *Table E-21*.

Table E-21. E1/T1 Statistics Parameters

Alarm	Failure	Comments
LOS	Loss of Signal	Sync LED Off • For T1: A second during which 192 contiguous pulse positions have no pulse of either positive or negative polarity (signal is more than 30 dB below nominal amplitude. • For E1: A second during which 255 contiguous pulse positions have no pulse of either positive or negative polarity.
LOF	Loss of Frame	Sync LED Off • For E1/T1: A second during which an OOF (see below) error persists for 2.5 seconds and no AIS error (see below) is detected.
LCV	Line Code Violation	Line Code Violation • For T1: A second during which BPV (Bipolar Violation) or EXZ errors have occurred. • For E1: A second during which two consecutive BPVs of the same polarity are received. BPV is the occurrence of a pulse with the same polarity as the previous pulse. EXZ is the occurrence of a zero string greater than 15 for AMI or 7 for B8ZS. Complies with ITU-TI.431, 0.161, G.775 and G.821 standards.
Rcv RAI (Yellow Alarm)	Remote Alarm Indication	Sync LED flashes • For E1/T1, a second during which tan RAI pattern is received from the far end when the far-end framer enters a RED state (Loss of Frame).
AIS	Alarm Indication Signal–Received from User	Sync LED is Off • For T1: A second during which an unframed “all 1” signal is received for 3 milliseconds. • For E1: A second during which a string of 512 bits contains fewer than three zero (0) bits.
FEBE	Far End Block Error	Number of seconds in which the FEBE indication is received from the remote E1 device. • For E1 MF-CRC4 only
BES	Bursty Errored Seconds (Errored Second type B)	Number of seconds with from two to 319 CRC error events with no AIS nor SEF (Framing Bit Errors) error detection Complies with AT&T TR-62411 and TR-54016 standards. Not applicable if Line Type is set to Unframed T1-ESF or E1-CRC4 modes

Table E-21. E1/T1 Statistics (Cont.)

Alarm	Failure	Comments
DM	Degraded Minutes	A Degraded Minute is calculated by collecting all of the available seconds, subtracting any SESs and sorting the result in 60 second groups. A Degraded Minute is a 60 second group in which the cumulative errors during the 60-second interval exceed $1x10^{-6}$. T1-ESF or E1-CRC4 modes
ES	Errored Second (If any error occurs during one second)	For E1/T1: Any second containing the following error events: • CRC • SEF (OOF) • AIS (T1 only). If SES is also active (see below) ES runs for 10 seconds and then stops.
SES	Severely Errored Seconds	Any second containing the following errored events is counted as severely errored seconds: For E1/T1: • If 320 or more CRC error events • One or more SEF (OOF) events • One or more AIS events occurred (for T1 only).
UAS	Unavailable Seconds	Activated when there are 10 consecutive SES occurrences and Deactivated as a result of 10 consecutive seconds without SES.
LOMF	Loss of Framing	Loss Of Framing sequence in Timeslot 16. E1 CAS mode only

The following parameters can be monitored from the Link Status menu:

Valid Intervals – number of 15-minute intervals stored in the system since power- up.

Time Since – elapsed time since the beginning of the current interval (interval 0). This is displayed only when the current interval is monitored.

Interval Number – number of the interval to be displayed.
Interval number 0 (zero) is the current interval.
The current interval display is continuously updated.
The elapsed time since the beginning of the interval is displayed.

Start Time – time and date when the monitored interval started. This is displayed only when viewing previous intervals.

Prev – displays the previous interval. From the first interval (current interval = 0) Prev is not visible.

Next – displays the next interval.
The number of valid intervals is displayed.
From the last valid interval Next is not visible.

ISDN Statistics in IPmux-1

Main Menu
↓
3. Performance Monitoring
↓
1. ISDN Statistics

```
                          ISDN STATISTICS
ISDN-S over UTP
LOF (Red):          0


ES:                 0
SES:                0
UAS:                0

Time Since:         710 sec    ------Valid Intervals         11----
1. Interval Number                          0
2. Channel Number                           1/1

ESC. Exit    N. Next Inv:
```

Figure E-30. ISDN Statistics Menu

Table E-22. ISDN Statistics Parameters

Parameter	Possible Values / Remarks
LOF (Loss of Frame)	A second during which a loss of ISDN frame occurs
ES (Errored Second)	IF SES is also active (below) ES runs for 10 seconds and then stops
SES (Severely (Errored Second)	Any second containing one or more LOF events
UAS (Unavailable Seconds)	Activated when there are 10 consecutive SES occurrences Deactivated as a result of 10 c0nsecutive seconds without SES

➤ **To view statistics for the next interval:**

- Press **N**.

Analog Status – IPmux-1E with FXS

Main Menu
↓
3. Performance Monitoring
↓
1. Analog Status

```
                          ANALOG STATUS
Channel 1:     ON HOOK
Channel 2:     ON HOOK
Channel 3:     ON HOOK
Channel 4:     ON HOOK


ESC. Exit
```

Figure E-31. Analog Status

The options for each channel are: **On-hook, Off-hook, Ringing**.

LAN Statistics (no User port)

Main Menu
↓
3. Performance Monitoring
↓
2. LAN Statistics

```
                          LAN STATISTICS
Mac Address                 00-20-D2-16-3B-3D
Mode                        Half duplex
Rate(Mbps)                  10
Status                      Not connected

Frames received from the user
    Correct frames:                     0
    Correct Octets:                     0
    Alignment Err:                      0
    FCS Errors:                         0
Frames transmitted to the user
    Correct frames:                     0
    Correct Octets:                     0
    Sngl Collision:                     0
    Mlty Collision:                     0
    Deferred transm:                    0
    Late Collision:                     0
    Carrier Sense:                      0


Esc. Exit      R. Reset Counters
```

Figure E-32. LAN Statistics Menu

LAN statistics are not collected in intervals.

➤ **To reset counters:**

Type **R**.

Table E-23. LAN Statistics

Statistics	Values	Description
MAC Address	Hard Coded	Port local MAC address
Mode	**Half duplex, Full duplex**	Port mode is set by either the default mode or via auto negotiation results
Rate	**10Mbps, 100Mbps**	Port rate is set by either the default mode or via auto negotiation results
Status	**Not connected, Connected**	Not connected: Link loss Connected: Normal operation
Frames received from the user		
Correct frames		Total number of correct frames received
Correct Octets received		Total number of correct octets received
Alignment Errors		Counter of frames received that are not an integral number of octets in length (RFC 1643)
FCS Error		Counter of frames received that do not pass the FCS check (RFC 1643)
Frames transmitted to the network		
Correct Frames		Total number of frames successfully transmitted
Correct Octets		Total number of octets successfully transmitted
Single Collision	Valid only in half duplex mode (RFC 1643)	Counter of successfully transmitted frames for which transmission is inhibited by exactly one collision
Multiple Collision	Valid only in half duplex mode (RFC 1643)	Counter of successfully transmitted frames for which transmission is inhibited by more than one collision
Deferred Transmission	Valid only in half duplex mode (RFC 1643)	Counter of frames for which the first transmission attempt is delayed because the medium is busy
Late Collision	Valid only in half duplex mode (RFC 1643)	Number of times that a collision is detected on a particular interface later than 512 bit-times into the transmission of a packet
Carrier Sense Error	Valid only in half duplex mode (RFC 1643)	Number of times that the carrier sense condition was lost or never asserted when attempting to transmit a frame

Bundle Connection Statistics

Main Menu
↓
3. Performance Monitoring
↓
3. Bundle Connection Statistics

```
                    BUNDLE CONNECTION STATUS
Destination IP Address:              192.192.192.1
Next Hop MAC Address:                00-00-00-00-00-00
Connectivity Status:                 LOCAL FAIL

Sequence Errors:                     0
Jitter Buffer Underflows:            1
Jitter Buffer Overflows:             0

Esc. Exit      R. Reset Counters
```

Figure E-33. Bundle Connection Status Menu

➤ **To reset counters:**

- Type **R**.

Table E-24. Bundle Connection Status Parameters

Parameter	Possible Values	Remarks
Destination IP Address		Destination IP address of the bundle configured under Bundle Connection Configuration
Destination Mac Address		In this screen Destination Mac Address displayed is in fact the resulting Mac Address of the ARP process for the destination IP address.
Connectivity Status	**Disabled**	Channel is disabled
	OK	Connection is Ok. Frames are received by the remote and the local IPmux
	Local Failure	Frames are not received by the local IPmux
	Remote Failure	Frames are not received by the remote IPmux
Sequence Errors		The number of times a frame was dropped because frames were received from the network with SN fields not equal to the last SN+1 (or 2)

Table E-24. Bundle Connection Statistics Parameters (Cont.)

Parameter	Possible Values	Remarks
Jitter Buffer Underflows		The number of times frames were dropped because the receive buffer was in an underrun state. The buffer enters underflow state when: • Sequence errors occur • Flow underrun takes place due to PDV expiration • An overflow condition occurs.
Jitter Buffer Overflows		Number of times that frames were dropped because the receive buffer exceeded the maximum allowed depth

E.11 Ethernet Configuration/Statistics Menus

User port is present

This section illustrates and describes the menus for IPmux-1/1E when the Ethernet port is present.

General Information

Main Menu
↓
1. System Menu
↓
1. General Information

```
                        GENERAL INFORMATION
Software Version               Hardware Version   Inventory No.
Boot:    1.21 7-1-2001 08:35   HW:1.0/0.0         232635
Application: 3.00-D1 9-2-2001 16:55
Backup: 3.00-D1 9-2-2001 16:55
Interface Description
  E1 over UTP
  ETHERNET over UTP

Press ESC to exit
```

Figure E-34. General Information Window – Two Ethernet Ports

Aging Time

Main Menu
↓
2. Configuration
↓
4. Switch Configuration
↓
2. Aging Time

```
                    SWITCH CONFIGURATION
1. LAN Configuration                        >
2. Aging Time <seconds>                     120


ESC. Exit
Select item from the menu.
```

Figure E-35. Switch Configuration – Two Ethernet Ports

Select Aging Time from 10 to 450 seconds.

LAN Configuration

Main Menu
↓
2. Configuration
↓
4. Switch Configuration
↓
1. LAN Configuration

```
                    LAN CONFIGURATION
1. Channel                              Network
2. Channel Status                       Enable
3. Auto Negotiation                     Enable
4. Max Capability advertised            100BaseT Full Duplex
5. Default type                         100BaseT Full Duplex
6. Rate limit <kbps> <0-Disable>        0


ESC. Exit                               N. Next
Select item from the menu.
```

Figure E-36. LAN Configuration – Two Ethernet Ports

Table E-25. LAN Configuration – Two Ethernet Ports

Parameter	Values	Remarks
Channel	**Network, User**	Selects port to be configured
Channel Status	**Enable, Disable**	When disabled, Ethernet LOS Events will not be sent to the Logfile
Auto Negotiation	**Enable, Disable**	
Max Capability advertised	**10BaseT Full Duplex, 10BaseT Half Duplex, 100BaseT Full Duplex, 100BaseT Half Duplex**	Default: **100baseT Full Duplex** ***Note:*** *This parameter is valid only when the Auto Negotiation mode is enabled (RFC 2239).*
Default type	**10BaseT Full Duplex, 10BaseT Half Duplex, 100BaseT Full Duplex, 100BaseT Half Duplex**	Default: **100baseT Full Duplex** ***Note:*** *This parameter is valid only when the Auto Negotiation mode is enabled (RFC 2239).*

Table E-25. LAN Configuration – Two Ethernet Ports (Cont.)

Parameter	Values	Remarks
Rate limit <kbps> <0-Disable>	**0 ..100,000**	Only relevant to Network port

Note *The Rate Limiter restricts the user port bandwidth:*
- *In steps of 50K, up to 5M*
- *From 5M–100M in steps of 1M.*

A more detailed explanation is found in Rate Limiter Mode *in* Chapter 1.

LAN Statistics

Three ports are connected to the internal switch:

- Network
- User
- Internal (TDMoIP/Host).

For further details, see *Ethernet User Port* in *Chapter 1*.

Main Menu
↓
3. Performance Monitoring
↓
2. LAN Statistics

```
                          LAN STATISTICS
Mac Address                 00-20-D2-16-3B-3D
Mode                        Half duplex
Rate(Mbps)                  10
Status                      Not connected

Frames received
    Total Frames:                       0
    Total Octets:                       0
    Oversize Frames:                    0
    Fragments:                          0
    Jabber:                             0
    Dropped Frames:                     0
    CRC Errors:                         0
Frames transmitted
    Correct frames:                     0
    Correct Octets:                     0
    Collision:                          0
Channel: Network/User

Esc. Exit     R. Reset Counters         N. Next Channel
```

Figure E-37. LAN Statistics Menu – Two Ethernet Ports (Network or User)

LAN statistics are not collected in intervals.

➤ **To view statistics for next channel:**

- Press **N**.

```
                          LAN STATISTICS
Mac Address                 00-20-D2-16-3B-3D
Mode                        Half duplex
Rate(Mbps)                  10
Status                      Not connected

Frames received
    Total Frames:                       0
    Total Octets:                       0
Frames transmitted
    Correct frames:                     0
    Correct Octets:                     0
Channel: Internal

Esc. Exit     R. Reset Counters         N. Next Channel
```

Figure E-38. LAN Statistics Menu – Two Ethernet Ports (Internal)

➤ **To reset counters:**

Type **R**.

Table E-26. LAN Statistics – Two Ethernet Ports

Statistics	Values	Description
MAC Address	Hard Coded	Port local MAC address
Mode	**Half duplex, Full duplex**	Port mode is set by either the default mode or via auto negotiation results
Rate	**10Mbps, 100Mbps**	Port rate is set by either the default mode or via auto negotiation results
Status	**Not connected, Connected**	Not connected: Link loss Connected: Normal operation
Frames received		
Total Frames		Total number of correct frames received
Total Octets		Total number of correct octets received
Oversize Frames		Number of frames that are too long, and CRC is valid
Fragments		Number of frames that are shorter than 64 bytes and have an invalid CRC
Jabber		Number of frames that are too long and have an invalid CRC
Dropped Frames		Number of dropped frames due to delivery problems
CRC Errors		The number of good frames with invalid CRC
Frames transmitted		
Correct Frames		Total number of frames successfully transmitted
Correct Octets		Total number of octets successfully transmitted
Collision		A counter of successfully transmitted frames for which transmission is inhibited by collision event, valid only in half duplex mode.
Channel1	**Network, User, Internal**	

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RAD

SUPPLEMENT

DC Power Supply Connection – Terminal Block Connector

Note: Ignore this supplement if the unit is AC-powered.

DC-powered units are equipped with a plastic 3-pin *VDC-IN* power input connector, located on the unit rear panel. Supplied with such a unit, is a mating Terminal Block (TB) type connector plug for attaching to your power supply cable.

Connect the wires of your power supply cable to the TB plug, according to the voltage polarity and assembly instructions provided below.

Caution: Prepare the connections to the TB plug *before* inserting it into the *VDC-IN* connector.

Preparing and Connecting the TB Plug

Refer to Figure 1 for assistance.

1. Strip the insulation of your power supply cable wires according to the dimensions shown.
2. Place each wire lead into the appropriate TB plug terminal *according to the voltage polarity mapping shown in Figure 2.* (If the terminal is not already open, loosen its terminal screw.)
3. Tighten the three terminal screws.
4. Pull a nylon cable tie (supplied) around the power supply cable to secure it firmly to the TB plug grip (pass the tie through the holes on the grip).

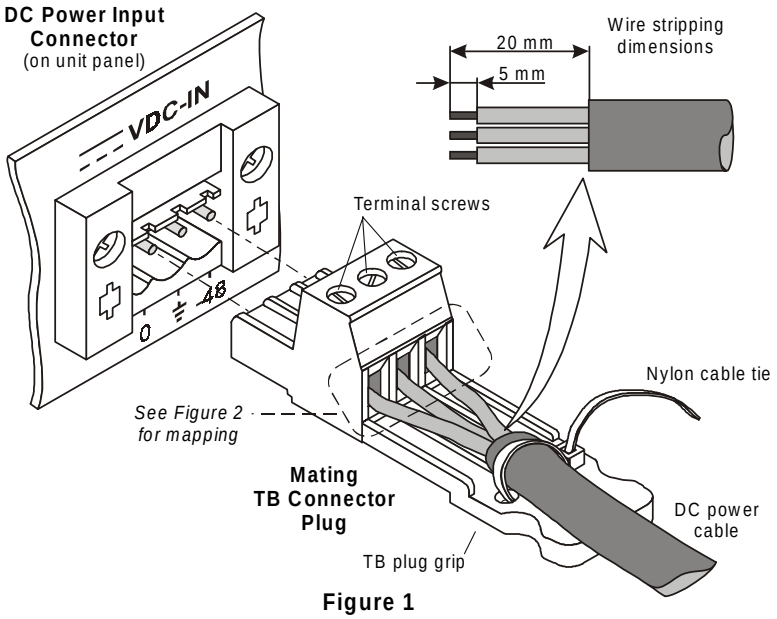

Figure 1

5. Isolate the exposed terminal screws / wire leads using a plastic sleeve or insulating tape, to prevent the possibility of short-circuit.
6. Connect the assembled power supply cable to the unit by inserting the TB plug into the unit's *VDC-IN* connector, until it snaps into place.

DC Power Supply Wire Voltage Polarity

Refer to Figure 2 for proper mapping of the power supply wire leads to the TB plug's three terminals.

> ***Warning:***
> *Reversing the wire voltage polarity can cause serious damage to the unit!*

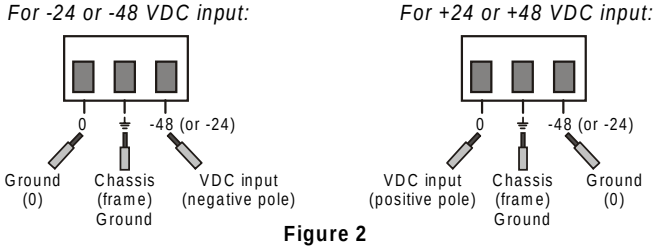

Figure 2